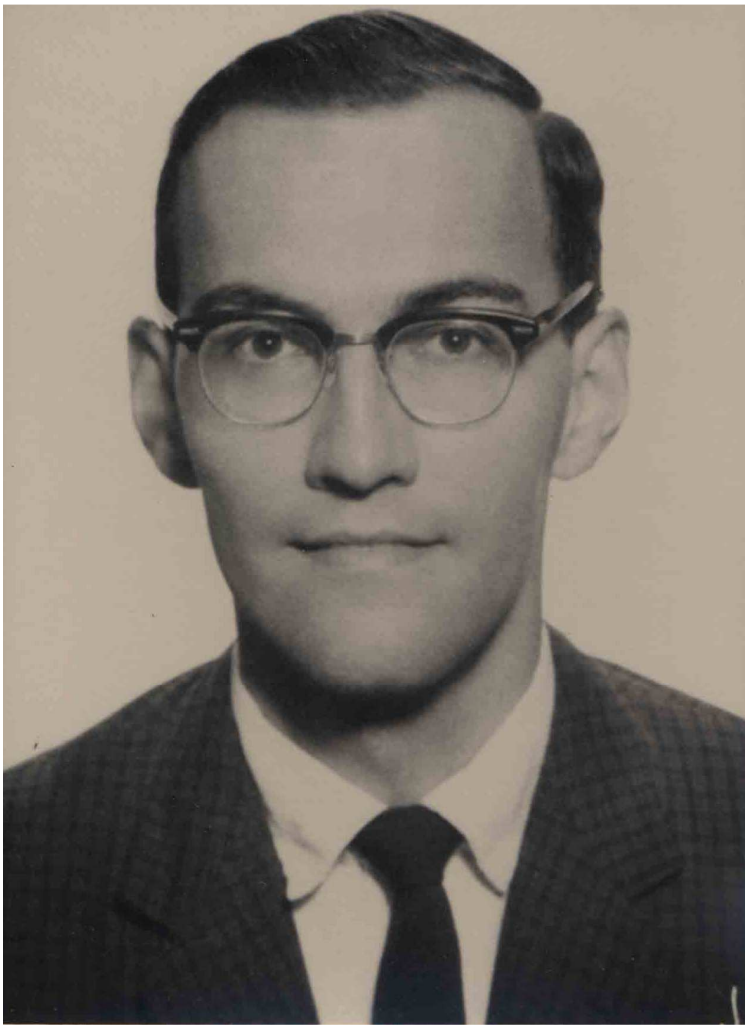
Half a Century of Ornithology in Texas:
the Legacy of Dr. Keith Arnold



Edited by Daniel M. Brooks

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Foreword

I had wanted to do something nice for Dr. Arnold as long as I knew him. Even as a grad student I was having fun, and was generally content with my work. For anyone that's ever been not content in grad school, you will understand that a lot of what leads to a happy and productive experience is a wonderful Advisor, which Keith Arnold was to a fault. Each time I successfully cleared a hurdle – passing oral and final defenses, completing my first major project in my career, even getting married and having kids, Dr A (as his students called him) presented me with a kind gesture - a book he knew I'd enjoy, or a card with well-thought, kind words inside.

Although I was honored to be a speaker at his retirement party, I failed miserably at nominating him for an award to the American Ornithologists' Union (AOU) upon his retirement in 2005. Luckily Doug Slack, his long-time friend and professional Colleague in WFSC at A&M, picked up the slack (no pun intended!) and nominated him as a Fellow to the AOU in 2006, the year following his retirement.

For years it nagged at me, how I failed to repay this kind man who had done so much for me and was a wonderful role model. Then I began to think along the lines of a Festschrift – a monograph or anthology of published manuscripts and memoirs dedicated to an honored individual. Sadly, in most cases such Festschrifts are done after the honoree is deceased; while the contributors can enjoy the contents and pat each other on the back, the honoree will never get to see the finished product. With that I pondered the idea of coordinating a Festschrift in honor of Dr A while he was still here to enjoy it!

So I gnawed on this idea in the back of my mind for several years before finally springing to action. Sadly, what finally did catalyze action was the passing of yet another mentor, who I was never able to convey my thanks to. When that unfortunate event happened I was done waiting around – the very next morning I contacted Dr. A with my idea, which he humbly approved, after intimating what a pleasant surprise it was. We then got to work on creating an author list, and the project began to take shape.

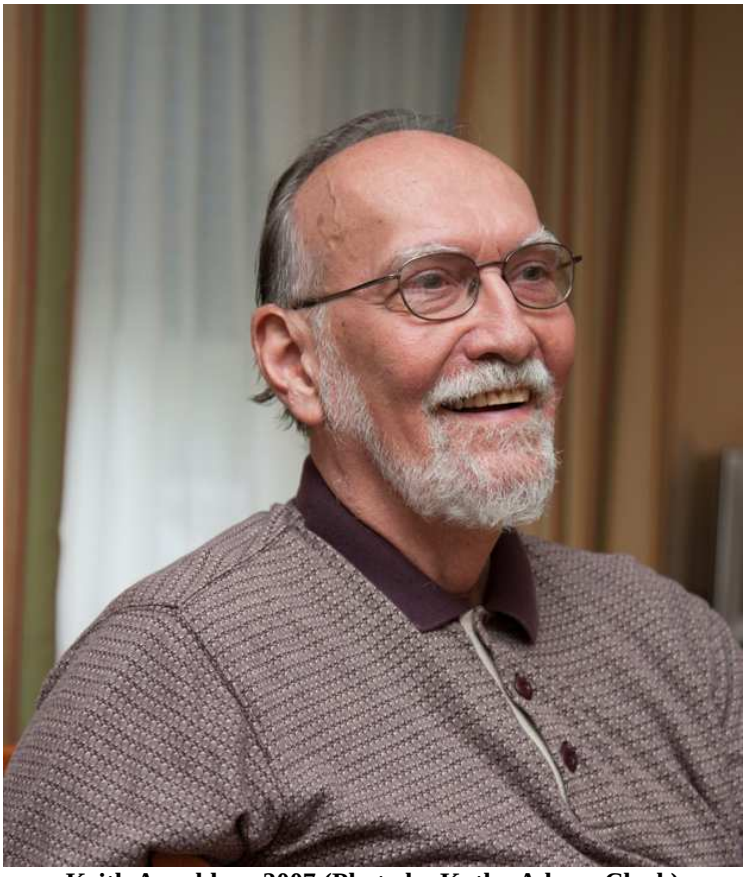
The initial invitation to authors was sent out 13 February 2017. At that time I was considering having only sections on Texas Ornithology (thus the title) and Memoirs (Encomia). However I also let the authors know that Dr A was especially fond of owls and wrens. Many people already knew he was very fond of owls, but wrens held several important firsts for him – his first publication ever (around 60 years ago!) was on Carolina Wrens, his first major research project was his PhD work on *Thryothorus* wren niche separation in Costa Rica, and his first piece of artwork in his private collection (which has grown vastly over the years) was of a Carolina Wren painted by Anne Pulich.

As the project unfolded, another small section of the book on Neotropical Ornithology formed. After that, there were several individuals who wanted to contribute, but weren't sure how exactly. Thankfully all of these individuals had the gift of a genuine artistic flair - thus another section was born, appropriately named Avian Art. These additional two sections were partly due to contributions of his faves, owls and wrens.

When the initial invite was sent out, I included a plea to shoot for first drafts by the end of April. Some contributions began to appear in March, and they continued to flow in through August. Once comments and edits were returned, within a couple of weeks I usually received a fresh copy back, and then quickly sent final galley proofs for approval. This process continued until we had the completed Festschrift at hand, with everyone's contributions.

Here's to you Dr A – heartfelt thanks from all of us, and enjoy reading!

- Daniel M. Brooks



Keith Arnold ca. 2007 (Photo by Kathy Adams Clark)

The Legacy of Dr. Keith Arnold

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Keith A. Arnold was born in Jackson, Michigan on 23 September 1937 during the Great Depression. His father, Berchard Arnold, was also a native of Michigan, born in 1904 in Hillsdale. Berchard was one of eight children; he had to quit school in the eighth grade to help support the large family when his father died. He held a variety of jobs but began working in a factory at the beginning of World War II. He also had a home delivery service for coffee, tea and other related products for several years. Keith Arnold's mother, Dorothy Arnold, was born in 1903 near Hillsdale, Michigan. Dorothy was one of 11 children, and was raised on the family farm until she went to live with her grandparents for high school and college. She entered Hillsdale College at the age of 16 and earned a degree that included coursework in five languages. She taught in public schools until her marriage. She then turned all of her attention to the task of raising her family. When her four children were all in school, she began substituting before finally returning full-time to the classroom. Keith's oldest sister became a registered nurse and had a long career. His older brother graduated from Kalamazoo College and went into the food services business, where he remained until retirement. His younger sister worked as a computer programmer for a major furniture company until her retirement. The entire clan of four siblings demonstrated a great work ethic. They were also prolific, all having two or three children each expanding the Arnold family legacy.

Early influences

When Keith was five he was trying to navigate the front porch steps with his sled. He tripped on the icy stairs and ended up in the hospital with a broken femur, and was put in a cast from waist down. During that time, his mother read him several Thorton Burgess books. These enchanting books about animals and nature are beautifully illustrated and were extremely popular in the early 20th century. Once free of the cast, he took interest in all living creatures. He said, "Mom put up with a lot of 'crawly' things in my pants pockets"! In the 7th grade, he was invited to join the high school biology club and met the club sponsor, Hazel Bradley. She introduced him to the diversity of life in the area, even in the Michigan winter. She became his mentor throughout high school and a good friend for more than 35 years.

During his intermediate years, a neighbor acquired an aquarium and some tropical fish. He convinced Keith to do likewise. He set up a two and a half gallon tank that an aunt gave him and bought his first fish: black mollies. It didn't take long to expand his collection, and on many occasions he traveled by city bus to the only local tropical fish store, which was located in the owner's home basement. He even tried to set up a store in his home during his high school years. This first foray into tropical fish ended when he entered college, but picked up again in later years

when he was first married (see below), expanding to several tanks in his lab on campus prior to his retirement.

Education

Keith attended Kalamazoo College from 1955-59, and earned a degree in biology. He chose Kalamazoo College because of its smaller size and reputation for excellence in the sciences. His older brother also attended that school and they were eligible for the family discount, which appealed to Keith since he worked his way through school. He had various odd jobs including janitor for the dining hall, library assistant and biology assistant. He says he was part of a freshman "revolt against the accepted expectations". He joined a Greek society, the Phi Lambda, which he reports was not noted for attracting jocks. He became close friends with five other young men, and they were, in his words, a "motley crew". They kept close tabs on all campus activity and eventually took over the school radio station. Keith had an hour-long jazz program daily. His scholastic mentor at Kalamazoo was Dr. H. Lewis Batts, Jr. While Batts' doctoral subject had been birds, he encouraged his students to develop a catholic taste in all things nature. During the three summers Keith was at Kalamazoo, he traveled with Dr. Batts and four other students for a month each summer. They journeyed around the U.S. visiting parks, monuments and refuges, experiencing nature and wildlife. When not exploring with Dr. Batts, Keith spent summers near his home in Jackson working for the Michigan Audubon Society day camp. He became director of the camp after his sophomore year. While at Kalamazoo College, he heard a lecture by a noted Stanford University professor who was one of the foremost ichthyologists of the time. The professor studied tropical fishes. Keith was inspired, and following graduation he set off to graduate school to study tropical fish.

He went to the University of Michigan graduate program with his sights set on getting a master's degree in zoology and physiology, which he assumed would lead to a lifetime of studying tropical fish. However, once he arrived at Michigan he did not seek out the staff ichthyologists and graduate students at the museum, but instead gravitated towards the bird people. Soon he developed friendships with the ornithology students who would get together at least once each week to talk with professors and one another about current trends in ornithology. It didn't take him long to realize that he knew a lot more about birds than fish. Drs. Bob Storer and Bud Tordoff, Ornithology Curators at the University of Michigan Museum of Zoology, became unofficial advisors and important early influences. Keith worked his way through Michigan as a lab tech for a protozoan geneticist. He graduated with a Master of Science degree in zoology and physiology in 1961.

Following completion of his Master's degree at Michigan, Keith decided to apply to Louisiana State University (LSU hereafter) because of Dr. Lowery's interest in tropical birds. George Lowery, Jr was perhaps the best mentor a student could have. He expected his students to work together and to play together, without question. His students were expected to attend home football games, and when the Tigers were on the road, they gathered at the Lowery home to enjoy the game together. Often on Sundays, the students would gather at the Lowerys' just for the comradery, and an occasional mean game of croquet!

Upon arrival at LSU in 1961, Keith met several of the Lowery "gang" who would become his closest friends: Burt Monroe, Del Barrett, Laurie Binford, Stuart Warter and Allan Hays. Alan Feduccia was an undergraduate who hung out at the LSU zoology museum and participated on a couple of collecting trips, later becoming a world reknown Paleontologist. Sid Gauthreaux was also an undergrad who developed an intense interest in avian migration using weather radar, and stayed at LSU for graduate studies. John O'Neill started his association with LSU while an undergraduate at University of Oklahoma (UO hereafter). Lowery found money for John to begin what became the long association between LSU and Peru. After completion of the UO degree, John entered graduate studies at LSU. The Lowery gang also included a couple of mammalogy students.

Shortly after Keith's arrival, Laurie and Del headed to Mexico for research in Tabasco and Oaxaca. Their departure came right after Hurricane Carla passed over the Louisiana Delta to landfall west of Galveston. Laurie called the Lowery gang from the coast, pleading them to come down and help salvage birds that had perished in the storm. They responded immediately, and helped salvage and preserve many Audubon's Shearwaters, Sooty Terns and a few other "goodies". That was Keith's first introduction to the closeness of Lowery's students. That closeness remained no matter where they went. Whenever they attended an American Ornithologists' Union (AOU hereafter) meeting, it was an LSU Museum of Zoology reunion. Burt, Laurie and Allan are now deceased, but Keith still remains in contact with John, Sid and Alan.

While at LSU, Keith participated in a hunt for Ivory-billed Woodpeckers on the Singer tract. The four students heard a sound that two thought was an Ivory-billed Woodpecker and two thought was a nuthatch. He refuses to disclose which group he was in! Another memorable experience was a competition in herpetology class which pitted individuals or teams of two against one another to find important records. They scoured the state of Louisiana, resulting in many new state records as well as increasing known distributions. One mammalogy student added several species of turtles by swimming underwater and catching the turtles as they sunned on logs - or so he claimed!

Keith's doctoral research was on the ecology of *Thryothorus* wrens. He spent 20 months over two years studying these birds in Costa Rica. During his first stint in Costa Rica, Volcán Irazú erupted, throwing ash across San Jose and the Central Plateau. When he returned two years later, he saw how the landscape had changed and recovered. He also collected many bird specimens for the museum, as did all of Lowery's students. Since he was the first LSU student to collect in Costa Rica, he added a number of species to the collections, including the first record of Yellow-headed Caracara for the country. His most memorable specimens were a pair of Quetzals he shot on the slopes of Volcán Irazú. On his second trip, Dr. and Mrs. Lowery drove down with a new Jeep to be used in Costa Rica. During their short stay, Keith took them across the Cerro de la Montaña where a magnificent male Quetzal flew across the road. He asked the Lowerys, "What else would you like to see"? One time Keith came across a Tropical Ratsnake (*Spilotes*) and White Hawk at the same time. He thought he could collect the snake first and then the hawk. Lowery was not impressed when he collected the snake and the hawk flew off, under no uncertain terms or words!

While at LSU, Keith was a teaching assistant in comparative anatomy, and a research assistant in the Museum of Zoology. He also was an instructor in general biology and zoology, and a pre-doctoral fellow with the LSU Medical Research and Training Center. In 1966, he graduated with a Doctor of Philosophy degree in zoology and physiology.

Academic teaching career

Soon after graduation, Keith applied and was subsequently interviewed for an assistant professor position as Ornithologist at Texas A&M University Department of Wildlife and Fisheries Science. He was interviewed by Dr. Richard (Dick) Baldauf, who was then acting department head, and the entire faculty of four! The other faculty members were Jim Teer, Jack Inglis and a graduate student fisheries instructor. William B. "Doc" Davis was unofficially retired and technically still on the faculty, but he did not take part in the interview other than meeting Keith. He was hired and the entire Wildlife Department staff went to the Ramada Inn club to celebrate. Thereby began an association and career with the university that lasted through his retirement in 2005, and continues with his active emeritus status that so far has extended his association with the university over 50 years and counting.

TAMU was an all-male military-based campus that began to change the same year Keith arrived. It was a bit more conservative than LSU, and a great deal more than the University of Michigan. The greatest difference was the lack of female students: only 73 in the fall of 1966, mostly wives or daughters of faculty and students. It was the previous year when membership in the Corps became voluntary and women could be freely admitted. The campus was definitely different from Kalamazoo College, both in the size and composition of its student body. Keith thought Kalamazoo had a more "homey" atmosphere.

Keith Arnold taught ornithology to over 2,500 students during his tenure at A&M. Besides general ornithology, he taught Field Ornithology, a graduate-level courses in Systematic Ornithology and occasionally Ornithology Seminar. For several years, he and Jim "Doc" Dixon shared teaching Natural History of the Vertebrates to the Texas Game Warden Academy, which was located on the campus at the time. After Dick Baldauf left in 1970, Keith taught courses in Museum Science and Nature Centers for Learning. He also occasionally taught a senior seminar.

Academic research career

He was also involved with field studies and individual research [WFSC 300, 489], sometimes as lone adviser, sometimes with other faculty. These courses included trips to Mexico; New Mexico and Arizona; south, central and west Texas; and Dominica. He took students to Dominica for seven consecutive years. He recounts one memory from a trip to south and west Texas when he was accompanied by Jim and Mary Dixon. The group had stopped for lunch along the Pecos River. He was preparing lunch, when he finally noticed some of the students a hundred yards or so down the road frantically trying to get his attention. When he arrived at their call, they pointed out a Common Black Hawk on a nest in a large tree. At the time this species was essentially (if not completely) unheard of in the state, and they remain very rare and localized today.

Keith was the major adviser to over 40 graduate students, who worked on a wide variety of wild birds. When Dick Baldauf departed, Keith inherited several Master of Agriculture students whose interests were in nature centers/teaching. When Bob Stickney left, Keith became co-adviser to a Ph.D. student working on tilapia, so finally returned professionally to fish! Keith's research projects spanned far in wide in Ornithology, with many focusing on interactions between birds and agriculture or economics. Some of his more memorable projects included long-term demographic studies on blackbirds and grackles, Wilson's Snipe (Collins was a long-time member of the snipe crew), and a breeding population of Henslow's Sparrows in Houston that he described as a new subspecies (*Ammodramus henslowii houstonensis*)! Projects he advised reached as far as inventories in Kenya, Fishing Owls in Taiwan, and avian diversity in South America. He has published over 75 peer-reviewed journal articles, as well as a book, "Birds of Texas", which is largely based on the results of the Texas Breeding Bird Atlas (see below).

Keith had many examples of great mentors in his life beginning with his mother, then Hazel Bradley in high school, Dr. H. Lewis Batts, Jr. at Kalamazoo, and finally George Lowery at LSU. It is not surprising then that he was a natural student advisor, counseling many young men and women during his career. The Vice Chanceller's Award in Excellence was established in 1980 to recognize the commitment and outstanding contributions of faculty and staff across Texas A&M AgriLife. Keith received the Vice Chanceller's Award in Excellence in Support of Student Counseling and Relations in 1993. He headed undergraduate advising from 1990 until he retired in 2005. The Margaret Annette Peters Advising Award, was established in 2000 to recognize and reward those faculty/administrators who embody the spirit of caring, compassionate, and genuine concern for the welfare of individual students. Only one professor is recognized annually. Keith received the college level Margaret Annette Peters Advising Award in 2001.

Collections for documentation

Keith Arnold's "baby" is the Collection of Birds at the Biodiversity Research and Teaching Collections (BRTC hereafter, formerly known as the TCWC [Texas Cooperative Wildlife Collections] during Keith's tenure). As of mid-April 2017 he had prepared 5510 specimens at TAMU, almost all ending up in the BRTC. That number includes several hundred mammals and herptiles. When he arrived at the university in 1966, the bird collections numbered 6872 specimens. His first addition was specimen number 6873, an Orchard Oriole. His final addition before he retired as Faculty Curator of the bird collection was number 14,601, a Red-footed Booby from Galveston. An extremely rare bird for the state of Texas, and a fitting final bird to punctuate Keith's tenure as Faculty Curator of Birds.

During his time at the BRTC, Keith grew the collection via his research (collecting over 1000 birds for his studies and also as part of Ornithology Field trips), his extensive salvage network (he has over 3700 salvaged birds that he prepared in the collection) and by accepting collections from UNT, SMU and Midwestern State. The collection of birds from Midwestern State included W.W. Dalquest's specimens from Mozambique, which contributed many unique species additions to the collections. He also traded some spare specimens from Mexico for a collection of eggs from the Houston Museum of Natural Science that make up most of the existing egg collection. Keith began growing a network of active birders across the state who salvaged birds for him. The network also included his bird banding sub-permittees. The specimens salvaged from this group

number several thousand and have historically been sent to the BRTC to be prepared as specimens for the collection. Today, Keith remains Curator Emeritus of *Birds***,** Biodiversity Research and Teaching Collections, enjoying the addition of each new specimen and each new student.

One unfortunate calamity that occurred in 1995 involved one-third of the collection being flooded. The collection was located in various areas over the years, with a long overdue move finally taking place when the collection outgrew its cramped quarters. Initially housed in the WFSC, the collection moved to a section of the TAMU library basement. Those quarters were extremely cramped and as was often the case, the move was long overdue with the specimen cases stacked three high! In 2005 a main water pipe in the library basement burst, leaving the lowest cabinets (one-third of the entire collection) totally submerged in water for an extended period of time. Not only specimens, but copious notes and data were also submerged, among other things. Upon arrival at the catastrophic scene, Dr Jim Dixon (Herpetologist) said, 'My life's work is underwater', as he quickly removed his shirt and swan dove in after the irreplacable material! Shelf-by-shelf, the water-soaked specimens were autoclaved, then frozen and finally dirt was removed using a fine brush. Brooks spent his Curatorial Internship in the TCWC brushing and re-curating the entire Ornithology collection! The lessons learned from a collection management perspective were priceless, but unfortunately the damage was very extensive. One fortunate 'upshot' of the whole disaster was permission granted to move the entire collections to a VERY spacious active warehouse next to the TAMU magnet lab, with plenty of room to grow. This spacious facility is on the other side of Highway 6 from the main campus, off University Drive. Due to the generous amount of space provided, above and beyond the physical space for the thousands of specimens, there are dermestid colonies (in the parking lot in back), prep labs, classrooms for WFSC vertebrate labs, and offices and lab space for grad students, curators and emeritus curators.

In 1970 Keith started the Texas Photo-Record File (TPRF hereafter) at BRTC for two reasons: first, at the time, there was much antagonism toward collecting among the Texas birding community, and second, there was no place or system to bring together photographic evidence of important Texas bird records. Today the TPRF is the official repository for the Texas Bird Record Committee (TBRC hereafter) records (see below). In addition to maintaining significant state records, it also catalogues regional and county records. The collection starts with a record of a White Pelican spotted on 19 November 1970. As of the spring of 2017, there are 3286 individual records catalogued, and a number waiting to be entered.

In 1972, George Newman, then president of Texas Ornithological Society (TOS hereafter) and a graduate student of Keith's, asked that he form a committee to consider and act on bird records for Texas. Keith asked a person from each TOS region to serve on the TBRC. At that time, sending records to the committee was not an easy task. Written material had to be duplicated and sent out to all members of the committee. Original photographs were passed from one committee member to another by mail. Greg Lasley was elected to the TBRC and became secretary. He developed a species review list and made the circulations of rare bird documentation more efficient. The current ability to send out documentation electronically has really facilitated the committee's work. In celebration of the 40th anniversary of the TBRC formation, the other committee members commissioned a painting of a Rufous-capped Warbler as a gift for Keith.

This species was chosen since Keith had collected the first specimen of the species for the state. Dennis Shepler, a former student of Keith, was the artist.

Rufous-capped Warbler painted for Keith by Dennis Shepler to commemorate the 40th anniversary of the TBRC.

Keith initiated the Texas Ornithological Archives (TOA) at BRTC when he ended his 30-year tenure as Texas Christmas Bird Count Editor. The archives contain every piece of information from those 30 years. The TOA includes the archives of the TOS since its beginning until communication became electronic. It also includes records from the TBRC. The archives hold all editor materials for National Audubon Society Field Notes and North American Birds for Texas from editors Keith Arnold, Greg Lasley and Chuck Sexton. It also includes original site records from Connie Hager, Doris Winship and Jack Kent.

Keith Arnold has been responsible for several noteworthy bird records. Few ornithologists in the latter half of the 20th century have managed to add a species to the US list, but Keith did. It was a Paint-billed Crake salvaged by one of his students. He also published the first specimen of the Greater Shearwater for the Gulf of Mexico. He further acquired several first specimen records for Texas, including Clark's Grebe, Arctic Loon, Jabiru, Rufous-capped Warbler and even several seabirds (Parasitic Jaeger, Band-rumped and Leach's Storm Petrel and Sabine's Gull) coauthored with Brooks.

Professional organizations

Keith's affiliation with the Texas Ornithological Society (TOS hereafter) began in 1967 when Jerry Strickling asked him to help with the spring meeting in College Station that year. His involvement grew and he eventually served as president from 1982 to 1985. He further served as treasurer of the organization from 1987 to 1995. In 1999, the TOS honored him with a lifetime membership, an honor only bestowed on nine previous recipients since the organization's founding in 1953. The presentation read, in part, "[Keith Arnold] has served TOS in many offices, many capacities and many ways. Throughout his distinguished professional carrier, Keith has been one of the loudest spokespersons on behalf of the contributions an ordinary bird watcher can make to the science of the study of birds". In 2001, Keith demonstrated that ideal by initiating the Texas Breeding Bird Atlas project using information derived from the state's birdwatching community between 1987-92.

Keith was also deeply involved with the Southwestern Association of Naturalists (SWAN). He became involved through his friend and co-worker, Jim Dixon, who was president of the organization from 1969-70. The organization was two years behind with the publication of its journal. Keith served as editor from 1970-74, and was able to get the journal caught up and have it edited and sent to the printer in a timely fashion. That was an especially difficult and time-consuming task in those times, before computers and email. He spent a great deal of time writing letters to authors and to the press that printed the journal. He went on to serve as president of SWAN from 1975-76.
Keith was nominated then elected an Elected Member of the AOU in 1980, and a Fellow in 2006. These honors stemmed in part from an AOU Meeting he co-hosted in College Station in 1979 with fellow Ornithologist professor Doug Slack. He remains a Life Member of AOU today.

Family and friends, community involvement

In late fall of 1967, the head secretary of the Wildlife Department asked if Keith would be interested in meeting a friend. Being single, and on a virtually all male campus where meeting single women was difficult to say the least, he agreed to a date for New Year's Eve. Unfortunately, he had committed to participate in the Freeport CBC which was also on New Year's Eve that year. He stayed at compiler Victor Emanuel's home the night before the count. Although no doubt exhausted from burning the candle at both ends, he showed well enough to manage a second date. Their second date was in a hospital. Beverly had suffered a whiplash injury in an auto accident. He met Bev's parents on that "second date". Apparently he impressed everyone on that date as well, because six months later, they were married.

During their first year of marriage, they lived in an apartment complex in Bryan. They became friends with another young family, and that family gave them a 10-gallon aquarium when they moved. Keith was off again keeping tropical fish. He bought a 20-gallon tank for his next birthday! His house is still adorned with a fish tank today, as was his the basement of his lab on campus.

Keith and Beverly have two children, Conrad and Jen. In spite of being taken to one Yell Practice when they were young, only Jen grew up to be an Aggie. Conrad is an Aggie fan and owns two

businesses. He has a grown daughter who graduated from the University of Texas in 2015, has a master's degree in Finance, and lives and works in New York City. Jen attended the University of North Texas for a Master's degree in Library Science and is a children's librarian in north Texas. Jen's daughter is also a Longhorn, in the University of Texas' nursing program.

Dick Baldauf, who hired Keith, became lifelong friends with the Arnolds. Jim and Mary Dixon brought their family back to Aggieland in 1967. He quickly became a good friend and a year later, that included their wives, Mary Dixon and Beverly Arnold. Jim took Keith for his first trip past the border region into Mexico in 1970, shortly after Hurricane Ella crossed northeast Mexico. It was a novel experience for Keith. They traveled in Jim's VW beetle, so things were rather tight. Keith had a Super 8 movie camera and tried get some footage of a Gray Hawk sitting on a utility pole. Every time Jim stopped, the hawk flew to the next pole. In spite of extended effort, he never succeeded. Apparently it ended his photography career, because in the near 50 years the authors have known him, we have never seen him take a picture of a bird. As they headed home up the east coast, they encountered a washout on the highway as a result of the passing hurricane. They had to wait for hours as a crew repaired the road before they could continue. Finally, as they approached College Station on FM 60 on a Saturday evening, it was a great feeling to see the lights of Kyle Field.

Jim and Keith shared a research project in the Trans-Pecos. Later on he and Jim led wildlife student trips to Mexico and Dominica, Arizona and New Mexico, and south and west Texas. The last of these trips, was one to Dominica in 1996, which they coined "The Jinxed Journey" – everything that could have gone wrong did! Jim, Mary, Bev and Keith had many good times together, including Bev's only "camp out" in the back of Jim's camper.

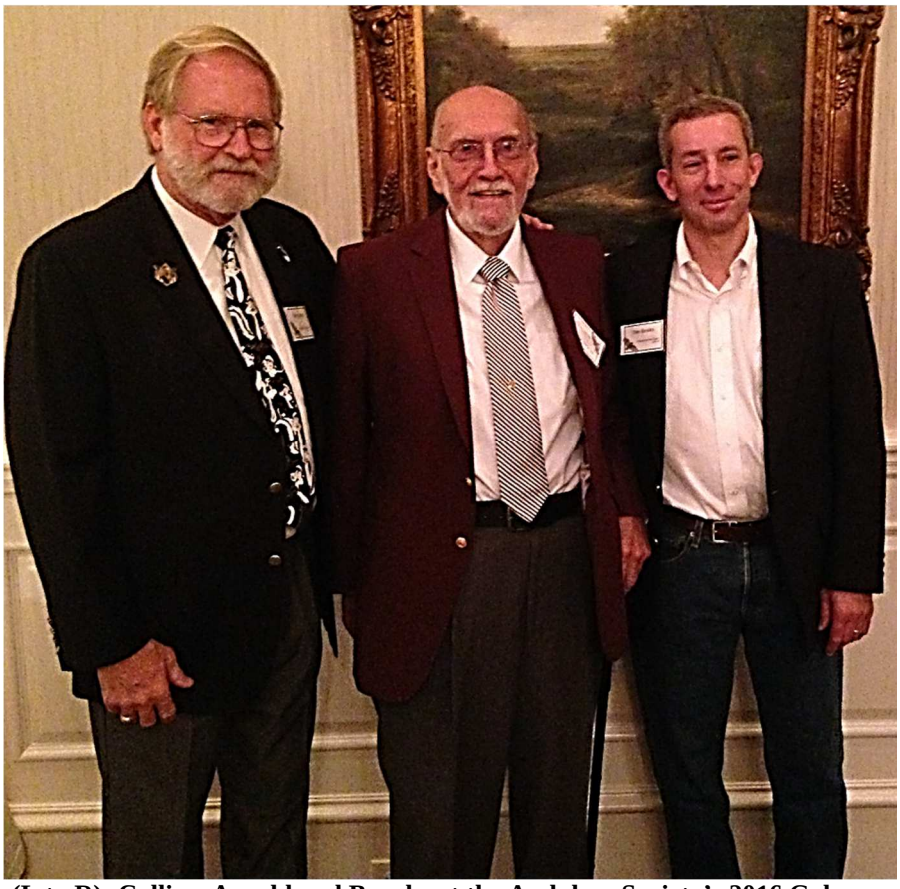
Working closely on many projects and sharing many graduate students created long-term and strong friendships with Doug and Charlotte Slack, Fred and Judy Smeins and Nova and Val Silvy. Keith also has remained close to many of his former students, especially his graduate students who reside in Texas, such as Dan Brooks, Fred Collins, the recently deceased Terry Maxwell (see Encomium), Cal Newnam and Randy Pinkston. There are individuals who he met and befriended through his position at A&M and in birding circles, such as Kelly Bryan, Warren Pulich, Ro Wauer and others too numerous to name.

Keith became involved with the Brazos Valley Museum in 1970, when he replaced Dick Baldauf on the Board of Trustees. He has continued to be associated ever since, although not always on the Board. He served as Board president at least 3 times. He was honored more than five years ago as a Lifetime Member of the Board. In 2014, he received the Volunteer-of-the-Year award from the Texas Association of Museums for his efforts on behalf of the museum. Obviously, after spending so many years with this organization, he has become close friends with many at the museum.

Keith and Beverly joined the A&M United Methodist Church in 1970. In the early 1970s, he served on the Administrative Board. For several years he headed up the church's Society of St. Stephens, which assists those in the community who need help. More recently, Bev and he serve as volunteers at the Coffee House, an outreach church program that serves college students. As

with all people who regularly attend church and Sunday school, the Arnolds' closest friends are those at their church.

Keith's lasting legacy on Texas ornithology is far greater than the records he made, papers he published or programs he initiated. Though these were important and their impact will continue far beyond his lifetime, his greatest legacy is the training and inspiration he passed on to his students and to the birding community members he came into contact with. They share an enthusiasm and dedication to furthering our understanding of the birdlife of Texas, and will continue to pass that along to future generations. As internet data becomes so great and widely available from diverse sources, it is unlikely that any future Texas ornithologist will have such a impact and prominence in the Texas birding community again. Keith Arnold may be the last great Texas ornithologist.



(L to R): Collins, Arnold and Brooks at the Audubon Society's 2016 Gala, where Collins and Brooks were recipients of the Lucy Wray Todd Award (Photo by Richard Gibbons).

TEXAS ORNITHOLOGY

Community ecology of ducks wintering along a southeast Texas urban gradient

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Abstract – Visual surveys of four lakes in southeast Texas were conducted to examine the relationships between lake morphometry and human presence to habitat selection of wintering ducks. Lake area and human disturbance have the most influence on habitat selection, with the latter having the most significant effect. The Theory of Island Biogeography was also applied to the data to explore the potential for using biogeographical approaches to understanding wintering habitat selection and future conservation implications. This study provides a baseline for future studies designed to understand factors affecting winter distribution of ducks in southeast Texas.

Migration is a fascinating phenomenon seen across the animal kingdom on small and large scales. The physiological, ecological and behavioral forces that drive duck migration have been the focus of many studies (e.g., Bellrose 1963, Johnsgard 1965, Able 1974, Robinson et al 2010, Arzel et al 2014, Shipes et al 2015, Takekawa et al 2015, Lonsdorf et al 2016). Habitat selection by migratory species and its relationship to the success of an individual and the community is an important paradigm in ecology (review in Arzel et al. 2006, Kaminski and Elmberg 2014). How and what information ducks gather of a potential habitat is a multidimensional process which can be influenced by lake area, inter-/intraspecific competition, morphology, previous experience, age/sex of the individuals and other factors (Reed et al 1999, Beatty et al 2014a,b).

Lake area is a widely studied environmental factor along with correlates of habitat selection (Elmberg et al 1994, Kosiński 1999). The size of the lake can affect habitat diversity, which in turn can lure various ecomorphological groups to the area, affecting intra-/interspecific relationships. This follows the spatial heterogeneity hypothesis, that greater environmental complexity in diverse habitats provides more diverse resources that can support more species (Nudds 1992). Individuals may also rely upon prior knowledge of an area to determine the benefit of a particular habitat (Nichols et al 1983). Distribution of species by age groups or sex has also been shown to affect habitat selection (Hepp and Hines 1991). These mechanisms that underlie habitat selection have been tested mostly during breeding season (Beatty et al 2014a,b).

Migratory ducks need to balance the cost of locating/selecting a specific habitat and the benefit that habitat can provide (Paulus 1988, Reed et al 1999, review in Kaminski and Elmberg 2014, Austin 2017). This cost:benefit ratio differs between breeding (high somatic/energetic cost) and non-breeding (low cost) sites due to food availability and quality more than other lake

characteristics (Suter 1994, Kosiński et al, 2006). Therefore we would expect to see a difference in habitat selection between breeding and non-breeding locations.

Disturbances from human presence/activity also can have an effect on habitat selection/avoidance. Many duck species will avoid disturbance, if the cost of selecting alternative sites nearby is comparatively low (Gill 1996, 2001).

Biogeography has its foundation in species distribution based on ecological drivers, among other factors (e.g., history, climate, geology). The Theory of Island Biogeography focuses on the spatio-temporal patterns of species colonization. Traditionally used to describe island colonization, the theory has been expanded to movement studies and preserve design for a variety of habitats and species (Miller 1976, Samson 1980, Wu and Vankat 1995, Cumming et al 2012). Integrating such concepts can provide additional information on species movements in relation to environmental influences. This can be used to assess whether environmental factors influence the dynamic equilibrium of habitat selection (i.e., immigration and extinction rates) by migratory ducks.

Southeast Texas is one of many areas utilized by migratory North American ducks during winter. This study was designed to evaluate the influence lake morphology has on migrant duck habitat selection along an urban gradient of lakes. Specifically, we explore patterns between species richness and abundance with lake size and human presence to examine the following questions:

1. Are there observed patterns in habitat selection measured as species richness and abundance in relation to lake size (i.e., surface area)?
2. Do human population density and proximity (distance from city) affect migratory duck habitat selection?
3. Can Island Biogeography Theory be applied to migratory duck populations in southeast Texas?

Data collected will provide a baseline index for migratory duck habitat selection in southeast Texas, which we hope will catalyze future studies.

METHODS

Four different lakes harboring migratory ducks were selected for sampling which offered an array of variation in size, distance to the city and human population density (Fig. 1). The largest lake was Mary Manor (N = 16 samples) at 992,008 m^2, a semi-private lake in rural Katy (Waller Co.) with some seasonal hunting. The second largest was at White Lake at Cullinan Park in Sugarland (Harris Co.; N = 18) at 145,620 m^2. Two much smaller lakes in Harris County included a private lake off the Bauer Rd frontage road on Highway 290 (herein referred to Bauer/290 Lake; N = 14) at 40,923 m^2, and McGovern Lake in Herman Park (N = 20) at 26,492 m^2 (Fig. 2).

Sampling took place during the duck migration/wintering season (November 2010 – March 2011). Species and number of individuals were documented. Most lakes were sampled weekly or slightly less frequently. Mary Manor Lake, White Lake, and Bauer/290 Lake were sampled with binoculars from a single vantage point that permitted full view of all ducks on the lake. Walking

the perimeter was necessary at McGovern Lake, which contained two large islands which ducks could hide behind.

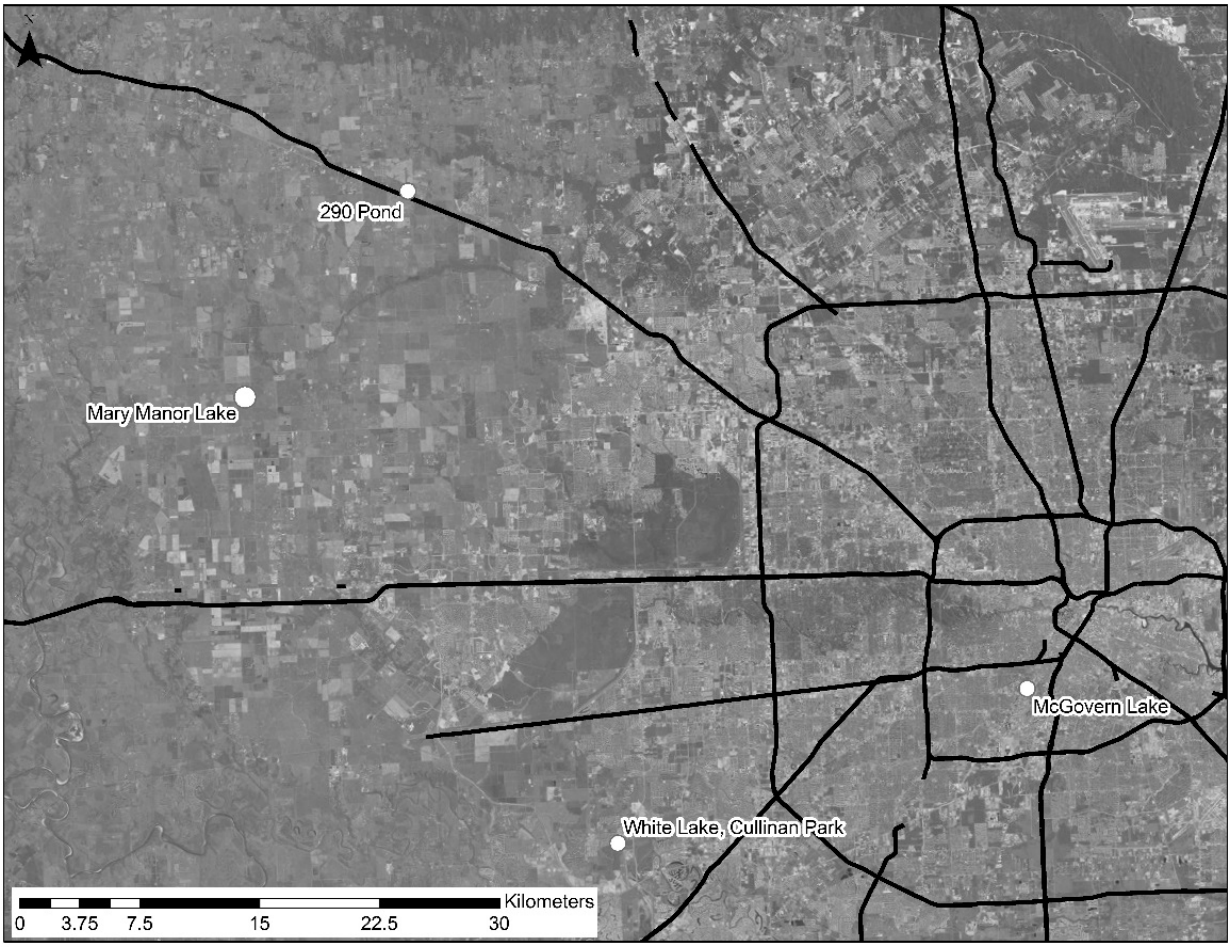

Figure 1 - Locations of Mary Manor, White, Bauer/290 and McGovern Lakes.

To analyze the spatial dispersal behavior of migratory ducks, several parameters were measured and calculated. Species richness, abundance and Simpson's index of diversity of ducks at each site were computed. Additionally, the surface area of each lake, km from city and human population density were obtained using U.S. Census Bureau (2010) data, and processed using ESRI (2010) with ArcGIS Desktop (2010). Distance to the nearest shoreline was measured as the shortest direct distance, and was invariably Galveston Bay. Distance from the nearest city was obtained by measuring the linear distance from each lake to city hall in downtown Houston.

Human population density was measured within a 1 km radius of each lake buffer. Site specific differences in species richness, abundance, index of diversity, species richness and abundance/m^2 of lake area among sampling sites were tested with a non-parametric Kruskal-Wallis Test. Pearson's product-moment correlations were calculated to test the relationship between environmental variables (lake area, km from city, population density) and species richness, abundance, index of diversity, species richness and abundance/m^2 of lake area. GraphPad InStat (version 3.06) was used for all statistical analysis.

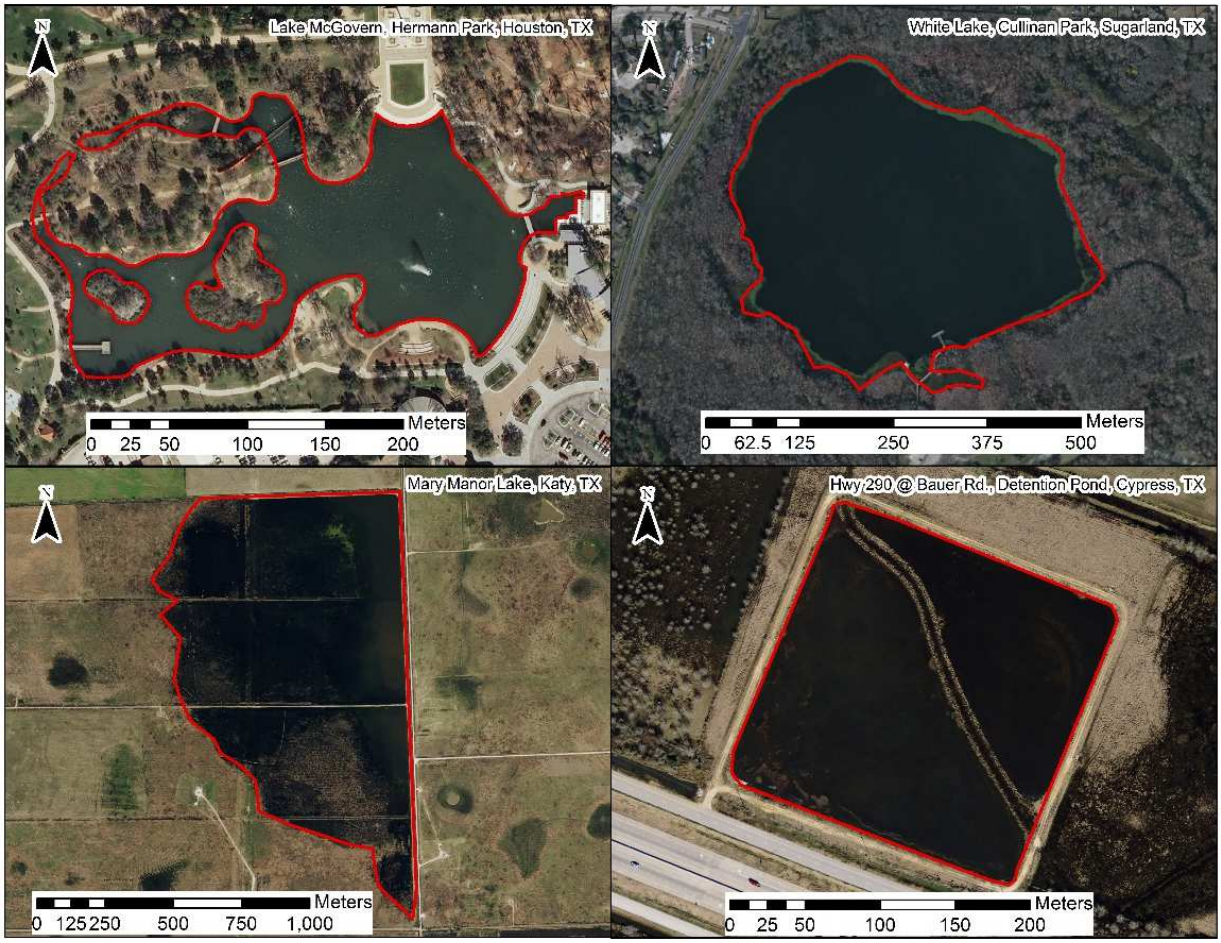

Figure 2 - Sizes and shapes of the four lakes in this study: McGovern (top left), White (top right), Mary Manor (bottom left), Bauer/290 (bottom right).

RESULTS

A total of 14 species of migratory ducks were identified during the sampling period across all four sites (Table 1). Species and abundance data were used to calculate species richness and diversity (Table 2, Fig. 3) for statistical comparisons of relationships among these variables to lake morphometry and human parameters (Table 3).

Lake morphometry

When considering all lakes, area had a positive relationship with index of diversity ($p<0.01$), species richness ($p<0.05$) and abundance ($p<0.05$; Fig. 4 A, B, C). However there were no significant differences in index of diversity, species richness or abundance for each of the four individual lakes ($p>0.05$), except for McGovern Lake which had a significantly lower index of diversity ($p<0.01$) and species richness ($p<0.05$; Fig. 3).

Table 1 - Average species composition at each of the four lakes over the survey period

Common Name	Latin Name	McGovern	White	Bauer/290	Mary Manor
Black-bellied Whistling-Duck	*Dendrocygna autumnalis*	70			
Wood Duck	*Aix sponsa*	2	2		
Gadwall	*Anas strepera*		47	23	23
American Wigeon	*Anas americana*		18	10	1
Mallard	*Anas platyrhynchos*				14
Mottled Duck	*Anas fulvigula*			5	15
Blue-winged Teal	*Anas discors*		13	20	73
Northern Shoveler	*Anas clypeata*		7	15	41
Northern Pintail	*Anas acuta*		3	5	10
Green-winged Teal	*Anas crecca*				40
Redhead	*Aythya americana*	2		1	1
Ring-necked Duck	*Aythya collaris*	34	31	31	
Lesser Scaup	*Aythya affinis*	2	4	4	
Ruddy Duck	*Oxyura jamaicensis*		5	4	1

Table 2 - Mean species richness, abundance and index of diversity for all lakes

Lake	Mean Species Richness	Mean Species Richness/m^2	Mean Abundance	Mean Abundance/m^2	Mean Index of Diversity
McGovern	3.29	0.00012	112.08	0.0041	0.38
Bauer/290	3.65	0.058453	56.73	0.00152	0.50
Mary Manor	4.53	0.000005	142.95	0.0001	0.64
White	4.32	0.000030	103.57	0.0007	0.59

Table 3 - Lake morphometric and human parameters measurements

Lake	Surface Area (m^2)	Km to Nearest Shore	Km from City	Population Density
McGovern	26,492	37	5	6911
Bauer/290	40,923	85	49	38
Mary Manor	992,008	89	52	28
White	145,620	63	31	5645

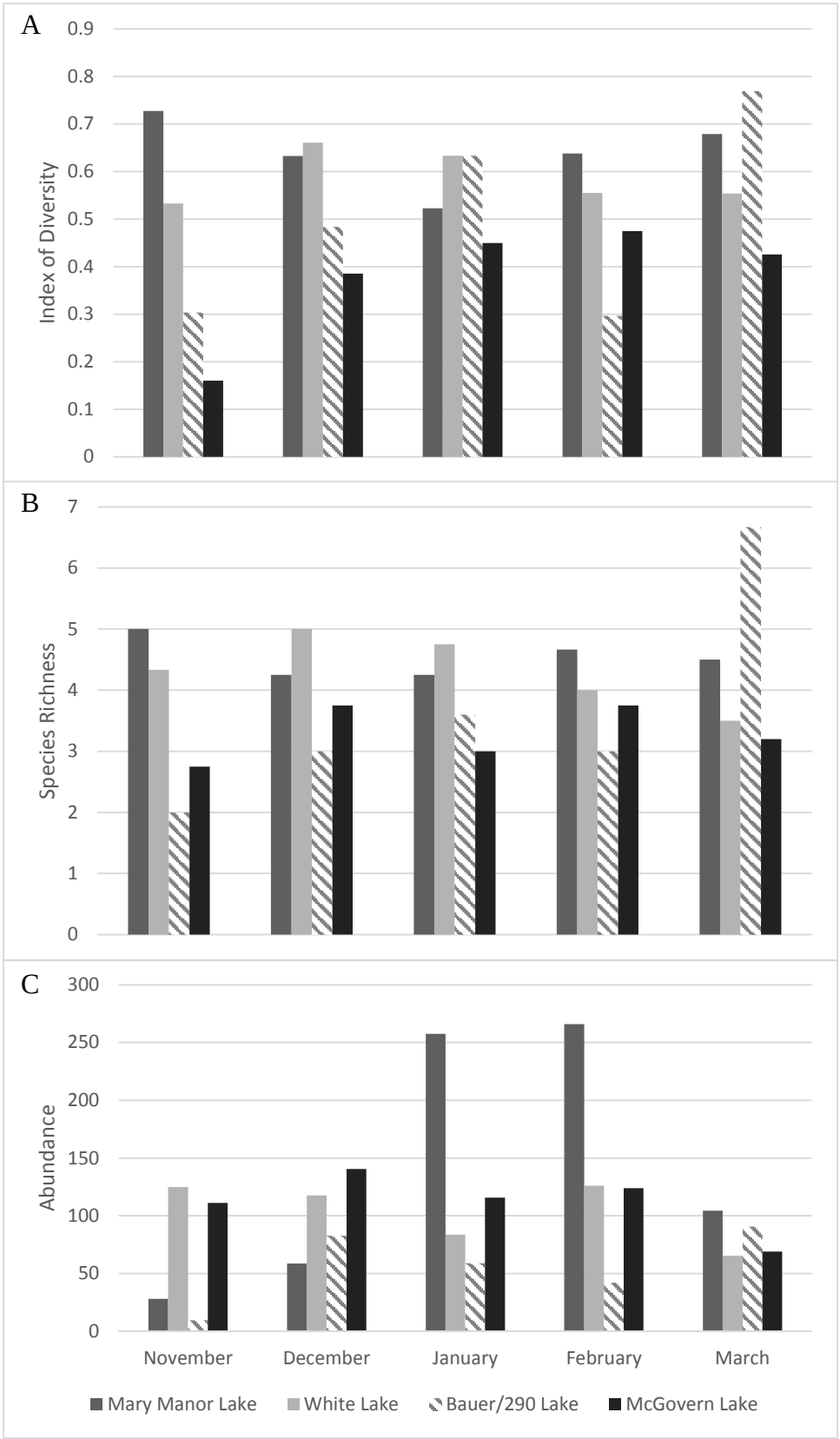

Figure 3 - Monthly index of diversity, species richness and abundance averages of all four lakes over the survey period.

For pair-wise comparisons of individual lakes, species richness/m^2 was significantly lower at Mary Manor Lake than Bauer/290 Lake ($p<0.001$) and McGovern Lake ($p<0.001$). White Lake had significantly lower species richness/m^2 than Bauer/290 Lake ($p<0.05$) but higher than McGovern Lake ($p<0.001$).

Mary Manor Lake had significantly lower abundance/m^2 than all other lakes ($p<0.05$), and White Lake had significantly lower abundance/m^2 than McGovern Lake ($p<0.001$).

Human parameters

Index of diversity ($p<0.0001$) and species richness ($p<0.05$) showed significantly positive relationships with distance from the city (Fig. 4 D, E).

Index of diversity significantly decreased ($p<0.01$) with increasing human population density (Fig. 4 F). Population density did not influence species richness or abundance statistically ($p>0.05$).

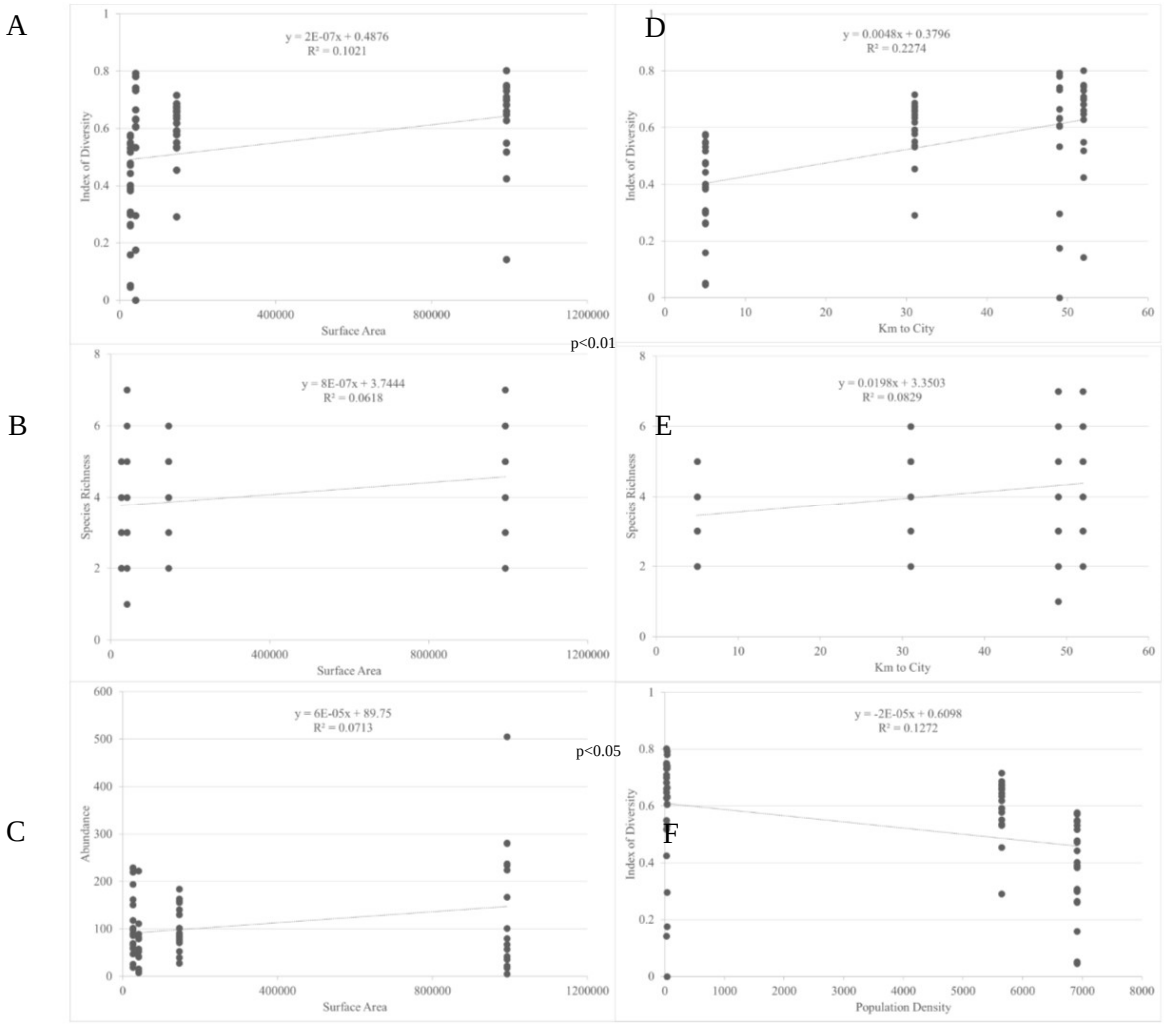

Figure 4 - Correlation analysis of index of diversity, species richness and abundance versus lake surface area, km from the city and population density.

DISCUSSION

Previous studies of migratory duck habitat selection have presented significant differences in distribution patterns (Hepp and Hines 1991, Elmberg et al 1994, Kosiński 1999, Reed et al 1999, Beatty et al 2014a,b). The majority of these results are based on breeding ground selection (Beatty et al 2014a,b). Here, we have collected data on non-breeding habitat selection to examine the effects that lake morphometry and human parameters have on migratory ducks settling in southeast Texas.

Historically, lake area has influenced distribution patterns of ducks more so than any other lake parameter (Elmberg et al 1994, Kosiński 1999). A similar trend is seen along the four lakes investigated in this study. As expected, these relationships suggest that as lake area increases, more species/individuals are found.

The basic systems of the lakes surveyed differ among one-another. Although not quantified, shoreline length and vegetation varies between each lake. These observations suggest that although a positive trend is seen in lake area, other measurements of lake morphometry do not seem to be a driver for habitat selection in migratory ducks.

McGovern Lake was the only lake significantly different with regards to index of diversity and species richness. McGovern Lake did have significantly higher abundance/m^2 compared to White Lake, however, this is based on mainly a single species identified only on McGovern Lake, the Black-bellied Whistling-Duck (*Dendrocygna autumnalis*). This whistling-duck does well around human development and can be found in large numbers in close contact with humans. McGovern Lake experiences heavy human disturbance (e.g., outdoor recreation) daily compared to the other lakes which are more sequestered from human activities. This, in addition to the negative trends seen in the index of diversity versus human population, suggests that human disturbance is an important factor affecting duck habitat selection across these four urban lakes.

Results suggest the perceived habitat does not appear to influence migratory ducks overwintering on the surveyed lakes. This agrees with previous studies that suggest foraging is the main driving force in habitat selection for non-breeding ducks (Paulus 1988, Suter 1994, Kuczyñski et al. 2006). The recorded distribution suggests that all four lakes sustain enough resources to support basic dietary needs. There appears to be no inter-/intraspecific competition with similar assemblages of species recorded among the lakes surveyed. This suggests the food resource capacity threshold of the habitat has not been reached, and species may be using the presence of conspecifics as a cue for habitat quality (Nichols et al 1983, Reed et al 1999, Kuczyñski et al. 2006, Austin 2017). Further studies investigating additional parameters are needed to confirm these results. For example, an aereographic characteristic that all of these sites share when viewing the lakes at a landscape scale, is aquatic vegetation and water that is clear enough to see the bottom. Water that is turbid and brown at a landscape scale are not selected by the ducks (F. Collins pers. obs.).

Although there are some identified trends, the species surveyed appear to exhibit flexibility in environmental variables (Hepp and Hines 1991) based on equal winter distribution across habitats. This evenness in habitat selection may be influenced by migratory ducks having

minimal time to survey and select an area (Paulus 1988, Reed et al 1999). Conserving energy would reduce their cost and balance out any difference in benefits provided by each habitat.

With regards to direct human interaction, there is a trend towards a non-random colonization of the lakes surveyed. The significantly lower index of diversity and species richness seen at McGovern lake may be a negative response in habitat selection due to disturbance (review in Arzel et al 2006, Kuczyñski et al. 2006, Beatty et al 2014b). This can be compared to White Lake which has a population of alligators that actively predate the ducks. The lack of behavioral response to a risk of predation versus avoidance of human interaction suggests human disturbance is considered a substantial risk to be avoided, whereas predation may occur in a habitat with compensating advantages (review in Arzel et al 2006, Austin 2017). Hunting (e.g., at Mary Manor) is another major human disturbance experienced by the species surveyed but was not analyzed in this study. Further surveys of known hunting grounds versus population dynamics (Brooks 1999) and the subsequent effect on habitat selection would broaden our understanding of overwintering habitat selection in migrating ducks. Annual data over a broad range would provide beneficial information on spatiotemporal variation and how this influences habitat selection.

If we view the data from a biogeographical standpoint, the distribution of migratory ducks in this study appears to be influenced by 'island size' (i.e., lake area) and agrees with predictions of equilibrium in island biogeography (Miller 1976, Wu and Vankat 1995). The effect of lake area follows the tenet of island biogeography that larger islands will support more species than smaller islands (Samson 1980, Wu and Vankat 1995). Further investigations are needed to detail this trend, to identify if there is a significant effect of lake area over a wider variety of lake sizes, and whether the trend is a response to only water surface area or habitat heterogeneity. Species richness/abundance parameters did not differ significantly across surveyed months within each site. An equilibrium appears to be achieved during the survey period with regard to species and abundance of individuals migrating to each lake (i.e., immigration/extinction rates). Additional year-long surveys could expand the equilibrium tenet to examine how migratory species affect lake communities.

The outcome of habitat selection is based on a number of related influences (Reed et al 1999, Beatty et al 2014a,b). Although the environmental carrying capacity appears to be equal across the surveyed lakes, there is a correlation between species richness/abundance parameters and lake area, suggesting size may be a factor in determining habitat selection (c.f., Brooks 2003) of ducks over-wintering in southeast Texas. Further research is needed to broaden the understanding of the mechanisms driving habitat selection. This information could broaden investigations to explore conservation and management efforts, as well as movement patterns in terms of island biogeography and habitat preservation.

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Swainson's Hawk (*Buteo swainsoni*) hunting behavior at an urban population of Free-tailed Bats (*Tadarida brasiliensis*)

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Abstract – We examined Swainson's hawks (*Buteo swainsoni)* hunting and feeding on free-tailed bats (*Tadarida brasiliensis)* during the summers of 2014 and 2015 in Houston, Texas. We documented activity patterns for bats and hawks, as well as aerial hunting and post-catching techniques of the hawks. Hawk hunting attempts significantly correlated with date (cumulative experience) during 2015, temperature and relative darkness during hawk arrival. Hawk hunting success correlated with date (cumulative experience) during 2015 only. Results are discussed in comparison to other studies. To our knowledge, this study investigated the first known sustained predation of free-tailed bats by Swainson's hawks in an urban setting.

Predation is assumed to act as a selective evolutionary force by impacting the fitness of both the predator and the prey at individual and community levels (Abrams 2000, Stevens 2010). Individual predators kill and consume prey for energy and sustenance, and those that catch enough food to survive and reproduce have opportunities to pass their genetic traits to future generations. Conversely, prey must avoid being captured and killed by predators in order to survive and reproduce. Models of optimal foraging predict that predators will maximize their rate of energy intake by selecting the most profitable prey (i.e., the young, sick, weak, or old; Greene 1986, Giraldeau and Caraco 2000). Consequently predation acts to cull vulnerable and weaker individuals from prey populations, leaving resources for fertile and healthy individuals and improving the overall health of the population as a whole (Genovart 2010).

Large bat colonies are known to attract a variety of predators, including many species of reptiles, birds and mammals (Davis et al. 1962, D. Brooks pers. obs.). In their daytime roosts bats are mostly inaccessible to terrestrial predators; terrestrial predators are opportunistic foragers, capturing vulnerable bats that fall to the ground (Baker 1962). Primarily volant predators (e.g., raptors) actively pursue and capture bats in flight during mass emergences (Davis et al. 1962). Baker (1962) reported the avian predators of Free-tailed Bats (*Tadarida brasiliensis*, hereafter *Tadarida*) including: Cooper's Hawk (*Accipiter cooperii*), Sharp-shinned Hawk (*Accipiter striatus*), Swainson's Hawk (*Buteo swainsoni*), Red-tailed Hawk (*Buteo jamaicensis*), Ferruginous Hawk (*Buteo regalis*), Hen Harrier (*Circus cyaneus*) and Great Horned Owl (*Bubo virginianus*). Another study documented Barn Owl (*Tyto alba*), American Kestrel (*Falco sparverius*) and Greater Roadrunner (*Geococcyx californianus*) as predators of *Tadarida* (Wilkins 1989). Harris's Hawk (*Parabuteo unicinctus*) and Merlin (*Falco columbarius*) have also been observed preying upon urban populations of *Tadarida* (Ortega-Álvarez and Calderón-Parra 2014, Martinez and Lee 2013).

Tadarida are abundant and widely distributed throughout North, Central and South America (Wilkins 1989). In the southwestern United States these bats form the largest colonies that have been reported for any mammal (e.g., Bracken Cave, Texas, ~20 million individuals; Davis et al. 1962). They roost in natural recesses such as caves and tree cavities or in anthropogenic structures such as culverts, bridges, attics and buildings (Wilkins 1989). They emerge *en-masse* from their dwellings around sunset and travel long distances to hunt for various insects throughout the night (Lee and McCracken 2005). Moths, beetles and true bugs are their most common prey (Lee and McCracken 2005).

Swainson's hawks (*Buteo swainsoni*, hereafter SWHA) are diurnal *Buteo* hawks that inhabit North America during the spring and summer, and migrate long distances to winter in southern South America (England et al. 1997). They have flexible diets that can include small mammals, birds, reptiles, amphibians and insects (England et al. 1997). They are primarily insectivores during the non-breeding season, consuming mainly grasshoppers, crickets and dragonflies (Johnson et al. 1987). There are limited published accounts of this species predating *Tadarida*, exceptions being studies of Looney (1972) and Baker (1962). The importance or mechanisms of *Tadarida* in the diet of SWHAs has not been investigated in these studies however.

Although *Tadarida* play ecological roles as both predator and prey, in the context of this study we investigated this species in its role as the prey of SWHAs. Specific objectives are: 1) describe and document the sustained predation of *Tadarida* by SWHAs in an urban habitat; 2) determine what (if any) factors correlated with predation attempts and successes of SWHAs; and 3) examine and document hunting and post-catching techniques of SWHAs on *Tadarida*.

METHODS

A *Tadarida* colony of ~250,000 individuals roosts in crevices underneath the Waugh Drive Bridge in urban Houston, Harris County, Texas (29°45'42.5"N, 95°23'54.0"W). This bridge is located in a densely populated area of the city with city park spaces, storefronts, and office and apartment buildings. The bridge spans Buffalo Bayou, and is utilized by vehicles, pedestrians and cyclists. At nighttime streetlights, vehicle headlights and storefront signage provide artificial light in the immediate area. In the absence of extreme weather conditions, these bats emerge from their roost nightly to hunt. Observations were conducted from the center of Waugh Drive Bridge on the pedestrian sidewalk.

Data collection was during summer when SWHAs were at their peak hunting activity, and bats were at their peak flight activity. Data collection took place during July – September 2014 and April – August 2015. We sampled during bat emergence, from just before dusk until full nightfall.

Two SWHAs were observed throughout the study using 10x42 Nikon Monarch and Oculus binoculars. We were able to identify the hawks as the same individuals by identifying missing wing and rectrix feathers. These birds were assumed to be a bonded male-female pair because they were territorial, chasing off conspecifics that entered the hunting zone during 25% (n = 4) of all sampling durations.

To determine correlates of hawk hunting success, hunting attempts and success (= # captures / # attempts) were each correlated with several parameters, including: date (cumulative experience), temperature (°C), cloud cover (clear = 1, partial = 2, overcast = 3), wind speed (MPH) and direction, hawk arrival time, relative darkness during hawk arrival and departure, bat emergence and exit (absence) time and maximum bat height during flight (m). We used an Apple iPhone 5S clock to record date and all arrival/departure times, temperature (using the weather application), wind speed and direction (using the Weather Underground application) and relative darkness (using the Light Meter application). Flight height of birds and bats was estimated by comparing with proximal buildings and extrapolating height per/floor.

RESULTS

Bat activity in emergence zone

Bats began emerging from the bridge between 19:41-20:35 hrs (mean = 20:08, N = 14) and were absent from the emergence zone by 19:46-20:58 hrs (mean = 20:33, N = 13). The total time of activity in the emergence zone averaged 26 min (range = 5-48 min, N = 13). Maximum flight height averaged 89 m (range = 22-350 m, N = 13).

Hawk hunting behavior

Hawks arrived on site to commence hunting between 19:39-20:20 hrs (mean = 20:02, N = 10) with a mean relative darkness index of 274 (range = 43-706, N = 14), ceasing hunting when the mean relative darkness index was 40 (range = 1-204, N = 14).

Aerial hunting behavior could be divided into three general patterns: diving (recorded during 93% of all sampling sessions, n = 13), in-flight pursuit (71%, n = 10) and circling (50%, n = 7). Diving, the most predominant behavior, involved a straight-line dive of 30-50 m (N= 10), invariably gaining higher speed than the bats were flying. On one occasion a hawk began to dive from ~100 m.

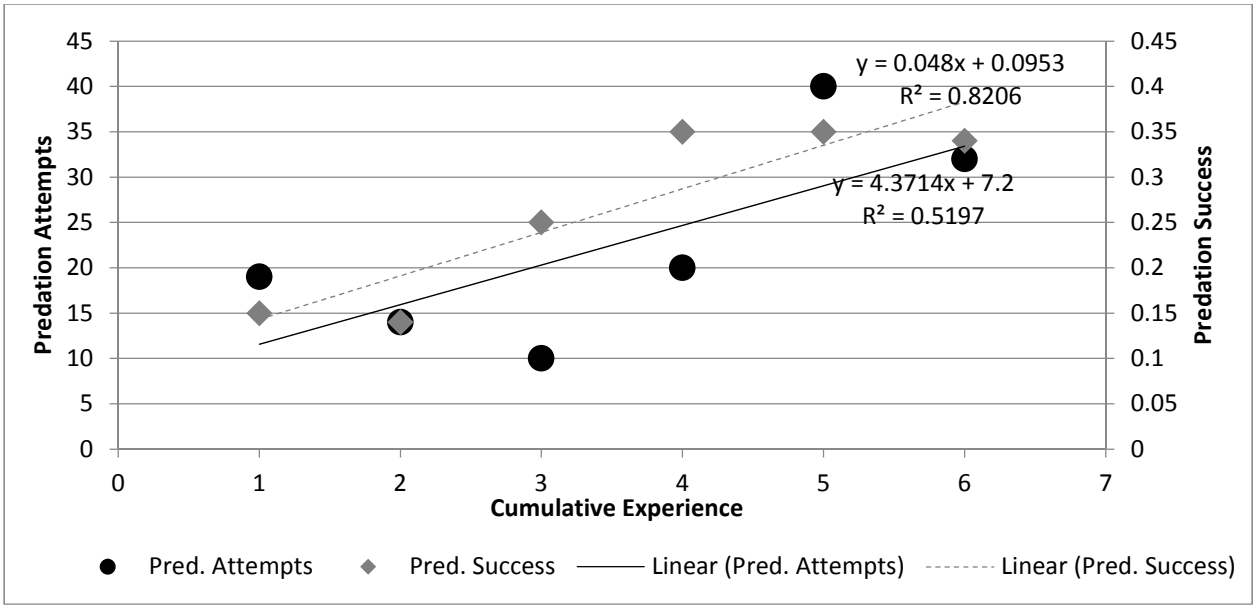

Figure 1 – The effect of cumulative experience on predation attempts and success (2015), both of which were positively correlated.

Predation attempts per sampling session ranged from 0-51 (mean = 21, N = 14), with hunting success ranging from 0-35% (mean = 17%, N = 14). Bats were consumed both in-flight on the wing (43%, n = 6) and while perched in a tree after catching (50%, n = 7). Five (83%, N = 6) of the observations of in-flight consumption took place during 2015, suggesting this behavior was favored during that year.

Correlates of hawk hunting success

Hawk hunting attempts significantly correlated with date (cumulative experience) during 2015 (r = 0.83, P = 0.04, N = 6; Fig. 1) but not 2014, as well as temperature (r = 0.54, P = 0.02, N = 14; Fig. 2) and relative darkness during hawk arrival (r = 0.47, P = 0.05, N = 14; Fig. 2). Non-significant correlations were found for cloud cover, arrival or emergence/absence time for hawks and bats respectively, relative darkness during hawk departure and maximum bat flight height. While wind speed and direction did not have enough samples to run correlations (N = 4 each), it appeared that these two parameters had little influence on hunting attempts.

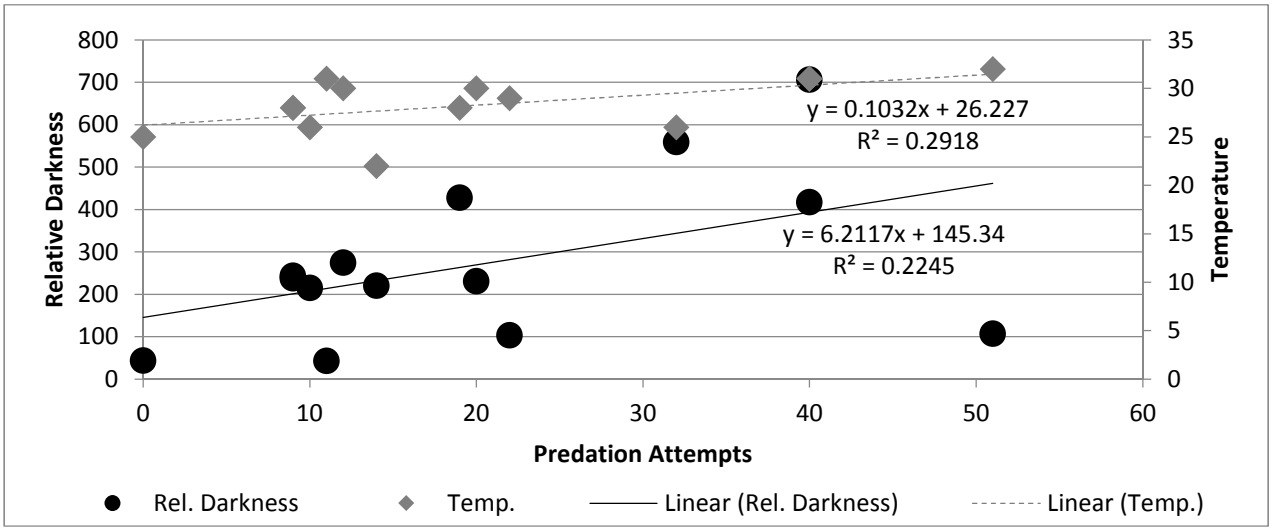

Figure 2 – The relationship between relative darkness and temperature on predation attempts, both of which were significantly correlated.

Hunting success was only significantly correlated with date (cumulative experience) during 2015 (r = 0.86, P = 0.03, N = 6; Fig. 1), but not for any other parameters.

DISCUSSION

Previous studies have found other species of raptors to display sustained predation on *Tadarida*, as we did with SWHAs. Martinez and Lee (2013) found Merlin made fewer predation attempts on bats than the SWHAs in our study, but had higher catching success rates (about a 50% rate of success catching at least 1 bat/attempt). This suggests that SWHAs may be less efficient at hunting bats than falcons such as Merlin. This essentially corroborated by Baker (1962) who described *Buteo* hawks to be no more than half as efficient at catching bats as Accipiters.

Some of the hunting and post-catching techniques that were utilized by the SWHAs in our study have also been documented in previous research. Baker (1962) recorded in-flight pursuit as a specific manner of attack used by SWHAs on *Tadarida*; we observed this technique in 71% of predation attempts. Our observation of SWHAs immediately transferring the captured prey to their bill and ingesting it whole in flight has been noted by Jaramillo (1993) and Sarasola and Negro (2005). However, they observed the hawk's prey consisting of insects instead of bats (Jaramillo 1993, Sarasola and Negro 2005). This suggests that some predatory behaviors of SWHAs may be applied to a variety of prey.

We predicted to find relative darkness to be correlated with hunting attempts given the diurnal nature of SWHAs and their requirement for suitable light conditions to hunt (Baker 1962). Contra to our results, Sarasola and Negro (2005) found the striking rate of SWHAs in their study to be negatively correlated with air temperature. Although the Sarasola and Negro (2005) study looked at a population of wintering SWHAs predating insects in Argentina, we would have expected to see similar results in our study. The positive correlation to temperature in our study may have been a consequence of more favorable weather conditions overall.

Although we gathered data on wind speed and direction in this study, we did not collect enough samples to run correlations. Yet, it appeared that these two parameters had little influence on the hawks' hunting attempts or successes. Lack of wind speed on aerial hawk strike rates has been documented in previous research (Sarasola and Negro 2005). In contrast, Baker (1962) described an anecdotal account of a gusty evening in which a SWHA missed a high percentage of strikes on *Tadarida*, with higher hunting success rates on two evenings with only slight breezes. These conflicting results indicate that further research should be conducted to determine the impact of wind speed and direction on predation attempts and successes of hawks.

Evidence of aerial predator-prey encounters between hawks and bats in an urban landscape might help to explain the mechanisms of novel prey selection by hawks in an unusual habitat. In addition, the large availability of bats in this urban setting could permit hawks to develop new prey-searching strategies to exploit a unique food source on their breeding grounds with a low energetic cost.

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Dispersal of Laughing Gulls (*Leucophaeus atricilla*) from a Texas colony

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Abstract - We banded 2934 Laughing Gull (*Leucophaeus atricilla*) chicks at a single colony in Texas from 1973-80 and an additional ~2000 chicks from 1981-87. Recoveries from these ~5000 banded chicks demonstrate dispersal from the colony eastward along the Gulf of Mexico coast to Florida, and southward along the coast into Mexico, hence into Central America and northwestern South America. First year birds appear to disperse farther than older birds.

The Laughing Gull (*Leucophaeus atricilla*) is an abundant gull species on the Gulf and southeastern Atlantic coasts of the United States and the only regularly nesting Larid on the Texas coast (Burger 2015). However, studies of this species relate mostly to nesting biology, behavior, and interactions with humans at landfills and airports (c.f., Burger 2015).

Four studies relate to the movements of Laughing Gulls from their breeding colonies. Forsythe (1972) reported on recoveries of birds banded in South Carolina. Southern (1980) analyzed continental Laughing Gull recoveries through the late 1970s, but excluded recoveries south of 19^0 N Latitude and did not consider age classes. Buckalew (1982) summarized recoveries from bandings in Maryland and Virginia. Belant and Dolbeer (1993) analyzed all band recovery records from the Northeastern US and the Gulf Coast through 1992, including banding data used in this study.

Herein we report exclusively on recoveries from birds banded as chicks at a single colony in Galveston Bay, Texas.

STUDY SITE AND METHODS

The gull colony has existed on a level, open site on Pelican Island (29.33º N, 94.81º W, Galveston Bay, Galveston Co., Texas; Fig. 1) for many years. This low natural island had been and continues to be enhanced with dredge spoil. The island first appears on nautical charts in 1824 at a size of about 4 ha; by 1945 the island had reached a size of about 43 ha. At the time of the study *Baccharis* sp. covered the higher parts of the island, and sea-oxeye (*Borrhicia frutescens*) and wolfberry (*Lycium* spp.) occurred in the drier areas. Tidal influence areas supported stands of *Spartina alternaflora*, while glasswort (*Salicornia* sp.) was present on sandy sediment (F. Collins pers. obs.). The area occupied by the nesting gulls consisted of a mixture of soil and shell.

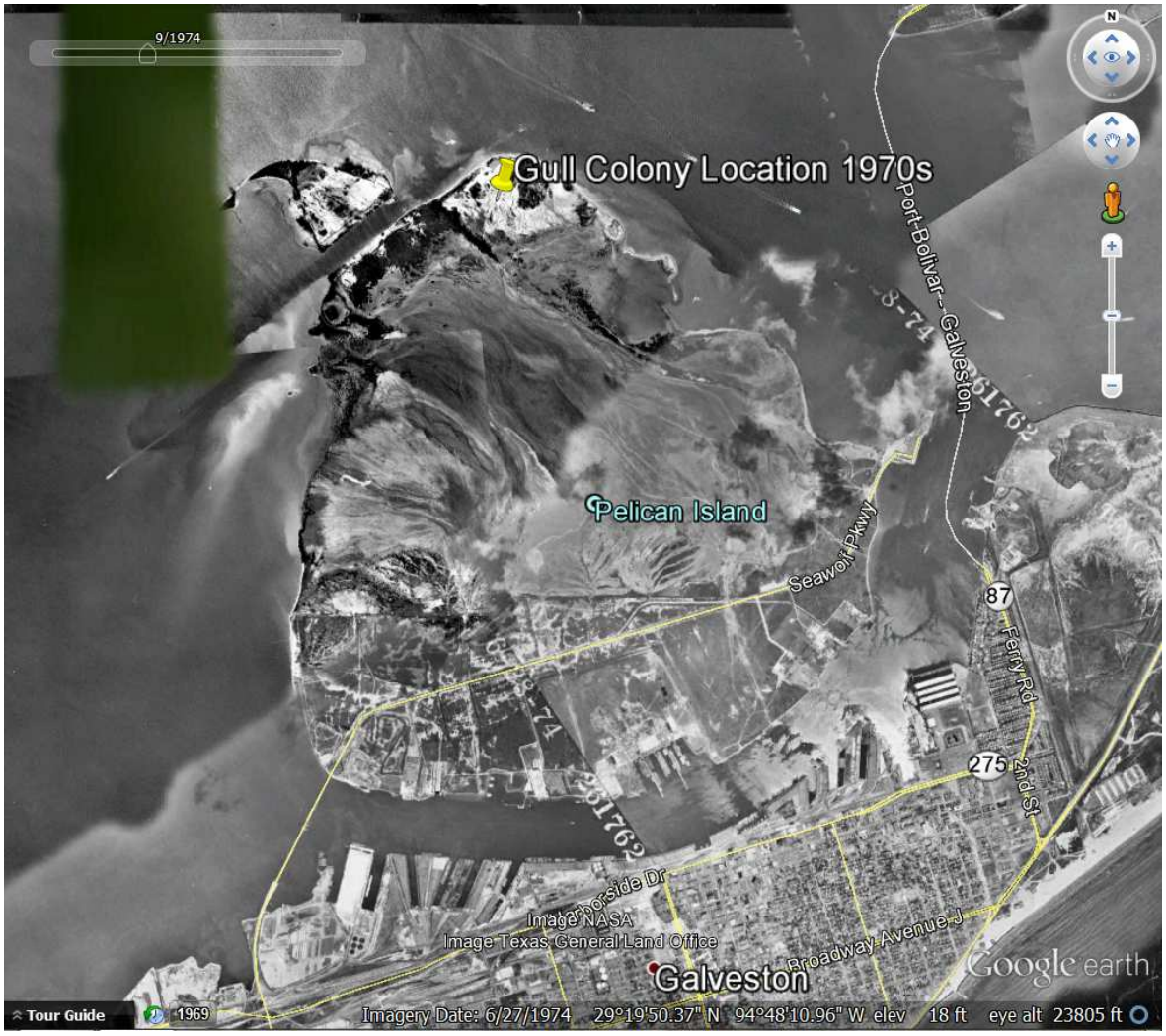

Figure 1 – Aerial map of Pelican Island (Galveston Bay, Galveston Co., Texas) 27 June 1974 (accessed from Google Maps 30 May2017).

Breeding Laughing Gulls reached about 30,000 birds in 1973 but declined to about 5200 after deposition of spoil on much of the island in 1977. The colony gradually increased in numbers until 1981 when imported fire ants (*Solenopsis invicta*) invaded the island; this resulted in a restructuring of the gull colony and reduced the number to about $\leq$ 10,000 breeding birds.

Gull chicks were banded during 14 breeding seasons. GFC began banding chicks in the Pelican Island colony in 1973, making 1-3 visits/breeding season. GFC and his assistants banded 2924 chicks from 1973-80. TLE and DRP led parties to the island from 1981-87 and banded an additional ~2000 chicks. Recoveries were obtained from the USGS Bird Banding Recovery website (USGS 2017). Data were tabularized for analyses (App. 1 and 2)

RESULTS

We received notification of 64 recoveries (~1.3%) of the chicks banded (App. 1, 2). The recoveries range from the Gulf coast of Florida south to the Pacific coast of Colombia, South America (App. 1, 2). Appendices 1 and 2 show the distribution of recoveries for first year and

subsequent age classes, respectively. Twenty-eight gulls were recovered during their first year cycle (App. 1), and 36 were recovered during subsequent age classes (App. 2).

Nine recoveries represent birds at or near the Pelican Island colony during a post-banding breeding season (App. 2). The remaining recoveries can be grouped into wintering gulls from the Gulf coast (Texas to Florida) and Latin America (App. 1, 2). Many band recoveries from Latin America involve gulls captured in fishing equipment or nets.

First year Laughing Gulls dispersed from the natal colony by mid-October (App. 1). All recovery data prior to that time involve locations at or near the natal colony in Galveston Bay. It is noteworthy that not all first year Laughing Gulls disperse great distances from the natal colony as evidenced by band recoveries from McFaddin Beach and Texas City early in the gulls' second year.

Figure 2 - Laughing Gull band return locations (1973-1987): Gulf of Mexico and Latin America.

Birds dispersed in two directions - either eastward along the Gulf of Mexico or southward along the coast to Latin America (Fig. 2). Three of 28 band returns (11%) involve gulls spending their first fall and winter in coastal Louisiana, while 19 of 28 (68%) involve first year gulls wintering in scattered locations along both coasts of lower Mexico, Central America, and northwestern South America. The two November returns from Padre Island National Seashore and offshore Veracruz, Mexico, could represent first year gulls in transit southward along the Gulf coast. Some gulls presumably cross to the Pacific side at the Isthmus of Tehuantepec. A single band return from west-central Guatemala could indicate another crossover route along the Rio Usumacinta and eastern flank of the Montanas del Norte de Chiapas. From the Pacific coast of northern Central America, band returns are equidistant north to Nayarit, Mexico, and Dept. Cauca, Colombia.

The oldest bird was a record of 29 years, involving a bird banded as a nestling in July 1977 and recovered near Galveston in February 2006.

DISCUSSION

Other studies have shown that first year gulls of several North American species disperse greater distances to wintering areas than gulls of older age classes. These younger, presumably nonbreeding gulls linger in such areas longer than gulls of older age classes (Southern 1980, Belant and Dolbeer 1993).

Additionally, Laughing Gulls do not breed until they acquire adult breeding plumage in their third year (possibly some birds in their second-year). Our data support this with an additional 13 band returns from Mexico and Central America of gulls in their second or third year, presumably nonbreeders regardless of the recovery season. Similarly, three of our returns involve second year gulls from coastal Louisiana or Florida. Only three of eight third year gulls were recovered in Texas.

Eubanks et al. (2006) suggest that Laughing Gulls might follow the coast around the Yucatan Peninsula to the Gulf of Honduras, and from there cross Central America to the Pacific coast. Support for this suggestion comes from two band returns from the Gulf of Honduras (Santo Tomas de Castilla and Puerto Barrios) and at least 10 returns concentrated along the Pacific coast of both Guatemala and El Salvador.

Site fidelity to the natal colony is very high in Laughing Gulls and other North American species. Belant and Dolbeer (1993) found that >50% of adult Laughing Gulls were recovered within 55 km of their natal colony. Similarly, our data show that 75% of adult gulls (8 of 12) were recovered at scattered locations surrounding Galveston Bay. The four band returns from Latin America involving gulls 3-8 years of age are difficult to explain. Perhaps some Gulf Coast gulls remain in Latin America and join breeding populations there.

The longevity record in our study of 29 years is the record age for Laughing Gull as a species (USGS 2017).

ACKNOWLEDGEMENTS

Daniel Pinkston aided with creation of the Figure 2 map. We also appreciate the help given by Michael Braun, Kassie Collins, Orlyn Gaddis, Walter Piper, Patricia Pinkston and many other individuals who helped in banding the gull chicks. Doug Slack and Nova Silvy reviewed earlier drafts of the manuscript.

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Appendix 1 – First year returns of Laughing Gulls banded on Pelican Island (1973-1987)

Date Banded	Date Recovered	Location Recovered
7/23/1973	6/24/1974	Port Aransas, Texas
6/30/1974	11/10/1974	California Point, Louisiana
6/29/1975	1/12/1976	Descondido, Guatemala
6/26/1977	11/15/1977	Veracruz, Mexico, 20 mi at sea
7/10/1977	1/28/1978	Rio Balsas, Michoacan, Mexico
7/10/1977	2/8/1978	2 mi W Cameron, Louisiana
7/2/1978	9/14/1978	Pelican Island, Texas
7/2/1978	1/29/1979	Acapulco, Guerrero, Mexico
7/2/1978	2/10/1979	Puerto Ocos, Guatemala
7/8/1978	1/3/1979	Suchitepequez Beach, Guatemala
7/16/1978	Dec-78	La Union, El Salvador
7/30/1978	11/20/1978	Lake Ponchatrain, Louisiana
7/30/1978	2/18/1979	Cloltepec, Oaxaca, Mexico
6/30/1979	1/24/1980	near Guapi, Dept. Cauca, Colombia
6/27/1981	10/17/1981	Cow Bayou, Texas
7/3/1981	1/14/1982	Quepos, Costa Rica
7/3/1981	2/9/1982	Santo Tomas de Castilla, Guatemala
7/3/1981	2/9/1982	Port of Puntarenas, Costa Rica
7/5/1982	2/13/1983	Zihuatanejo, Guerrero, Mexico
7/2/1983	3/8/1984	Achotines, Panama
7/2/1983	4/2/1984	Champerico, Guatemala
6/30/1985	9/1/1985	Bolivar Flats, Texas
6/30/1985	11/24/1985	Padre Island National Seashore, Texas
7/7/1985	Nov-85	Zihuatanejo, Guerrero, Mexico
7/6/1986	9/22/1986	Galveston, Texas
7/6/1986	1/18/1987	Boca de Apiza, Colima, Mexico
7/3/1987	1/8/1988	Laguna Mitla, Guerrero, Mexico
7/3/1987	2/4/1988	Punta Burcia, Costa Rica

Appendix 2 – Second and subsequent year returns of Laughing Gulls banded on Pelican Island (1973-1987)

Date Banded	Date Recovered	Location Recovered	Age (yrs) at Recovery
6/30/1973	6/26/1977*	Port Bolivar, Texas	3
6/16/1974	6/14/1976	Venice, Louisiana	2
6/30/1974	11/26/1976	Baytown, Texas	3
6/29/1975	5/10/1977*	Galveston Bay, Texas	2
6/29/1976	10/15/1977	Texas City, Texas	2
6/26/1977	11/25/1978	Petacalco, Guerrero, Mexico	2
7/10/1977	1/10/1979	10 mi W Holly Beach, Louisiana	2
7/10/1977	1/15/1983	near Baytown, Texas	5
7/10/1977	7/4/1983*	Seabrook, Texas	5
7/10/1977	Feb-06	near Galveston, Texas	29
7/8/1978	11/20/1980	Champerico, Guatemala	3
7/8/1978	3/9/1983	near Tirra Blanca, El Salvador	4
7/8/1978	2/13/1981	Miguel Aleman, Veracruz, Mexico	3
7/8/1978	1/1/1980	Pinotepa Nac, Oaxaca, Mexico	2
7/8/1978	4/30/1981*	Hannahs, Texas	2
7/16/1978	11/20/1980	Champerico, Guatemala	3
7/16/1978	10/1/1979	Descondido, Chiapas, Mexico	2
7/16/1978	11/16/1981	Galveston, Texas	4
7/30/1978	4/10/1984*	Baytown, Texas	5
6/27/1981	1/9/1983	93 mi W Champerico, Guatemala	2
6/27/1981	4/25/1984*	Galveston Island, Texas	3
6/27/1981	8/9/1988	near Ixchel, Guatemala	8
7/3/1981	11/13/1983	Villa Morelos, Nayarit, Mexico	3
7/3/1981	5/19/1984	Aldama, Tamaulipas, Mexico	3
7/3/1981	12/6/1982	Puerto Vallarta, Jalisco, Mexico	2
7/3/1981	8/26/1987*	San Luis Pass, Texas	7
7/3/1981	9/9/1985	18 mi S Anahuac, Texas	5
7/5/1982	10/25/1987	Tahuesco, Guatemala	6
7/1/1984	11/5/1985	Oaxaca, Mexico	2
7/1/1984	1/5/1986	Barrio La Esperanza, Guatemala	2
7/1/1984	1/6/1986	Crystal Beach, Texas	2
7/1/1984	4/14/1989*	Bolivar Peninsula, Texas	5
7/8/1984	8/11/1987	La Ceiba, Honduras	4
6/30/1985	7/1/1986*	McFaddin Beach, Texas	2
6/30/1985	8/10/1986	near Treasure Island, Florida	2
6/28/1986	11/28/1987	Costa Rica	2

* Recoveries at or near the Pelican Island colony

Ecology, behavior and reproduction of an introduced population of Scaly-breasted Munias (*Lonchura punctulata*) in Houston, Texas

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Abstract - Results of a citizen-science project are reported to better understand potential impacts of an introduced population of Scaly-breasted Munias (*Lonchura punctulata*) in Houston, Texas. Houston records of munias accounted for 96% of all sightings in Texas. Nearly two-thirds of munias are found in urban habitats, with the remainder in more natural areas, especially parkland. A globose-shaped nest is built with young raised between early April - late September, and several nesting events are described. Munias are non-migratory, with flock size averaging 6.1 (range = 1-30), and three larger 'mega-flocks' are described. Munias are completely unaggressive towards other species and are observed foraging at feeders with 22 other species, of which 32% are other introduced species. The species most frequently associated with munias are House Finches (*Haemorhous mexicanus*) and American Goldfinches (*Spinus tristis*) which combined represented over one-half of all associations. Frequent behaviors included foraging (38%), vocalizing (24%), and perching (16%). The most common of the 25 species of plants used for perching are oak trees (*Quercus sp.*) and crepe myrtle (*Lagerstroemia sp.*), and 60% of the plants are native to Texas, while exotic plants are species both from within (24%) and outside (16%) the munia's native range. General biology is similar between Houston munias, native populations in Asia, and other introduced populations. The alien population in Houston is not firmly established beyond the Houston region in the state of Texas, does not compete with native species, and is not a serious agricultural grain pest, but should continue to be monitored.

An expanding population of an invasive exotic species can exert significant pressure on local ecology and native biota (Lockwood et al. 2007). However, some of these introduced populations can become integrated into a local community of organisms with no harm to the native species (Brooks 2013). A typical pattern of population establishment of introduced species is when cage birds escape or are released, then gather, reproduce, and undergo population expansion (Brooks and Page 2012). However, ecological traits of an introduced species and the native community, as well as abiotic factors and habitat, all may influence population dynamics of invasive species (Eguchi and Amano 2004).

The Scaly-breasted Munia (*Lonchura punctulata*, hereafter referred to as 'munia') is native to southern Asia (Pakistan through Vietnam, southeast China, and the Philippines) and is relatively inexpensive in the global pet trade (Long 1981, Brooks and Page 2012). Due to their popularity in the cage bird market, munias have been introduced to various regions of the globe, including the United States (California, Florida, and Texas), numerous islands (Mauritius, Reunion, Seychelles, Tahiti, Yap, Palau, Hawaii, Jamaica, and Puerto Rico), archipelagos (Japan and New Zealand), and the east coast of Australia (Long 1981, Garrett 2000, Duncan 2009, Brooks and

Page 2012, Pranty 2011). Introduced munias are especially numerous in river drainages (Garrett 2000) and are resilient in wet and mesic weather events (Duncan 2009). In their native range munias are also highly adaptable, occurring in a variety of human-modified habitats (Restall 1997). Consequently, it is likely that ecological plasticity of the munias played a strong role in its successful global invasions.

Munias have been considered a grain crop pest in southeast Asia (Ali 1953, Cheng 1963, Long 1981) and Hawaii where they are invasive (Caum 1933, Hawaiian Audubon Society 1975), as well as a potential competitive threat to native finches where they are invasive (Long 1981). In light of these potential threats, we are interested in determining whether munias are potentially harmful to the environment where they were introduced in Houston, Texas. Moreover, detailed research of introduced populations of munias are lacking, with the exception of studies on ecomorphological competition in Hawaii (Moulton et al. 1992) and reproduction and habitat use in California (Smithson 1997).

To better understand the impacts of introduced munia populations in the Houston, Texas region, this species is included as one of six targeted avian species of the Texas Invasive Bird Project (TIBP), a citizen-science study initiated in 2008. Herein we utilize data generated from TIBP to describe range dispersal, reproduction, ecology, and behavior in this introduced munia population, to determine whether there is currently any negative impact on native species or landscapes in the Houston region. We hypothesize this species is not currently an ecological threat in Houston.

METHODS

To document introduced bird species in the area, we carefully designed a questionnaire to be made available at several local bird watching clubs, annual bird watching festivals, circulated on Texas bird watching internet List-Servs, and posted at the website: hmns.org/InvasiveBirds.doc. The majority of the questionnaire respondents fell into two broad categories: (1) birdwatchers who are familiar with munias, and (2) naturalists who enjoy observing urban wildlife that visits neighborhoods and parks. In cases of wildlife that could not be identified, most of the respondents sought help on the internet which ultimately led to the munia photograph on the questionnaire. When returning the questionnaire, most respondents indicated they were enthusiastic about being able to identify the bird they saw.

Respondents seemed honest and conservative; if they did not know the answer to a given question they left it blank or stated they did not know. In most cases, respondents included voucher photographs and/or a written description of the birds and habitat to confirm documentation. We proofed the citizen-scientist data for accuracy to ensure that birds, plants, habitat, and abiotic parameters were accurately designated and identified by: (1) examining all photographs and (2) ground-truthing ~15% of the sites via direct visits. In some cases, we were able to obtain plant, habitat, and abiotic parameter data from submitted photographs if those portions of the questionnaire were left blank. In a few cases where plants were not obvious, we confirmed species designation with a museum staff botanist (N. Greig).

We tabularized results in a database for analyses. When responses were anthropomorphic, we interpreted the information accordingly (e.g., “a couple of birds popping food in the mouths of smaller brown guys” = “a pair feeding their young”). In cases where reports provided numerical

data in feet or inches, we converted the data to m or cm. When numerical data were provided as a range, we used the average between the minimum and maximum (e.g., perched 3–5 feet = 4 feet = 3.3 m). We did not include insufficiently completed questionnaires in analyses.

Sampling dates spanned nearly seven years (June 2008 - February 2015), and information is still being collected for possible future analyses. Older dates preceding the initiation of the study (June 2008) were obtained from respondents and E-bird reports (eBird 2015).

For the distribution portion of the study, location coordinates were obtained using Google Earth, and each was digitized on a map using ArcGIS (2014). Each location was grouped by year and assigned a greyscale symbol, with earlier sightings shown in black to the most recent shown in white. Habitat association, nest biology and age structure were analyzed by combining collated data and photos. For flock dynamics, data on unusually large flocks ($\geq$ 50) were excluded from analyses and described separately since all but three flocks observed were $\leq$ 25 individuals. The large flock from West Houston contained two munias that presented with yellow bands on the right leg, which allowed us to address seasonality by accounting for their presence over time. Interspecific interaction and activity patterns were analyzed by collating data.

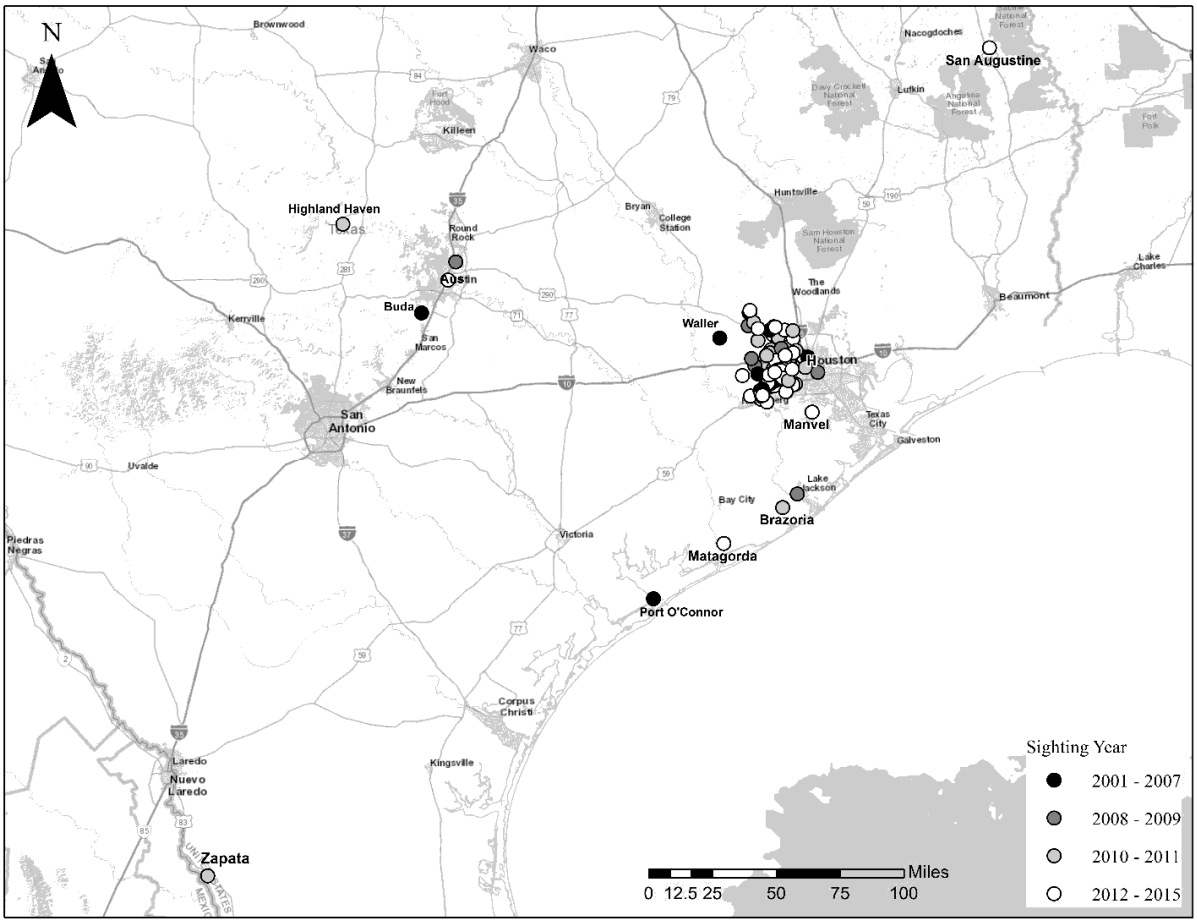

Figure 1 - Distribution of Scaly-breasted Munias in the state of Texas, data collected Oct 2004 - Feb 2015.

RESULTS

Distribution

Only 4% (N = 220 different sites) of all records are from other parts of the state outside the Houston area. These areas are centered around Austin (n = 4), the upper-mid Texas coast (n = 4), and single records near the Big Thicket and in the upper Rio Grande Valley (Fig. 1).

Munias were observed at 210 sites in the Houston area, mostly concentrated in the southwest region along the border of Harris and Ft. Bend counties (Fig. 2). Major reservoirs include northern Addicks Reservoir/Bear Creek Park (northwest, Fig. 2, inset 1), central Cullinan Park (southwest, Fig. 2, inset 2), and Willow Waterhole Greenway (southeast). The earliest recorded sighting (October 2004) was at Arthur Storey Park. Overall, it appears that the population is slowly moving northeast, towards sites closer to the city (Fig. 2).

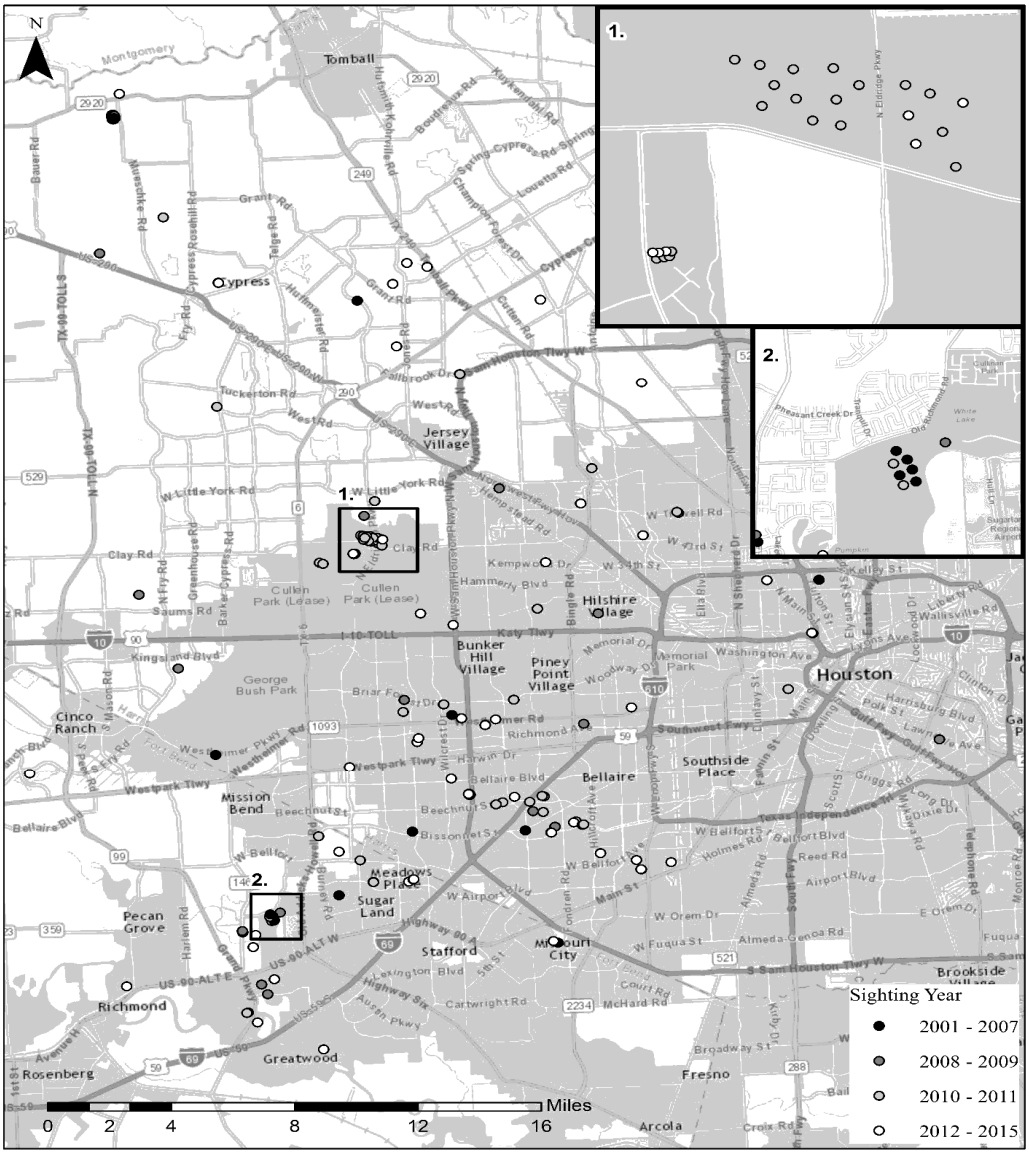

Figure 2 - Distribution of Scaly-breasted Munias within Houston, Texas (shaded) and surrounding areas.

Habitat

The majority of munias (n = 470) are in urban habitats such as backyard gardens with bird feeders. Other sightings in more natural areas included vast areas of parkland (N = 282), including Kleb Woods Nature Preserve (n = 190), Addicks Reservoir/Bear Creek Park (n = 74), Arthur Storey Park (n = 10), and various reservoirs and drainage basins (n = 8).

Nest biology

The munia nest is an enclosed globose ball made of plant material (e.g., leaves, twigs, grass, N = 4), has a mean diameter of 30 cm (range = 28-32.5 cm, N = 2), and height off the ground ranges 1.8-4.0 m (mean = 3.2 m, N = 4). Of 11 observations involving nesting activity, eight are of adults gathering nest material and nest building (early April to late September), two of an active nest (May and August) and one of a nearly abandoned nest (mid-September). Details of five different nests are described below (chronologically by month).

In June 2013 a pair of munias was observed building a nest at the entrance to Arthur Storey Park in southwest Houston. One bird was initially observed in a reed bed at the southernmost edge of the lake stripping off and carrying reed slivers to the nest. Both adults wove the slivers into the nest opening for at least 20 min to reinforce the 4 cm entrance hole located on the bottom half of the nest. The nest was a globose mass 30-35 cm diameter, comprised of non-leaf plant material such as dried reed slivers, grasses, and twigs. It was approximately 4 m above ground level in a small Yaupon tree that contained several Great-tailed Grackle (*Quiscalus mexicanus*) nests. One of the nests located $\leq$ 0.65 m from the munia nest was active with a grackle nestling. A Northern Mockingbird (*Mimus polyglottos*) was also seen entering and exiting the same tree.

In late July 2012 a munia was observed carrying nesting material to a nest at a semi-urban residence in Tomball, TX. The nest was located approximately 3.3 m above ground level in a tall pine tree (*Pinus sp.*).

In August 2006 a pair of birds built a nest in a Pineapple Pear tree (*Pyrus communis*) in a rural homestead yard in Waller County. The nest was a globose mass of small twigs built in the crotch of the tree approximately 1.8 m above ground level. The munias were observed on several occasions perched in the tree, as well as entering and leaving the nest area.

In September 2009 a pair of birds were building a nest in a Crepe Myrtle adjacent to a 0.2 Ha pond near an office park in West Houston. The nest was a 28 cm diameter globose mass of dried leaves from Crepe Myrtle and Juniper (*Juniperus sp.*), and the munias often perched 0.7-1 m above the nest. The height of the Crepe Myrtle tree supporting the nest was 3.8 m, with the base of the nest 3 m off the ground, and the thickest DBH of the tree 9 cm. After one week the nest was thought to be abandoned until a single bird was observed flying from the nest two weeks after the initial observation, although fledglings were never observed.

In late September 2011 a pair of munias were building a nest in a small Live Oak (*Quercus virginiana*) near a small cluster of strip-shops in semi-rural Sugarland. One of the birds was carrying a long blade of grass to a large globose nest.

Age structure

Adult munias outnumber juveniles in 55% of sightings, juveniles outnumber adults in 32% of sightings, and adults and juveniles are in equal proportions in 14% of sightings (N = 22). During the year the number of juveniles slowly increased, beginning in June, until ratios of adults to juveniles are equal in the fall. There is a slight decrease in juveniles during November, perhaps accounting for younger birds adjusting to the first cold temperatures of the year. The ratio of adults to juveniles increased progressively from winter through spring until only birds in breeding plumage are observed by the beginning of the breeding season in April (Fig. 3).

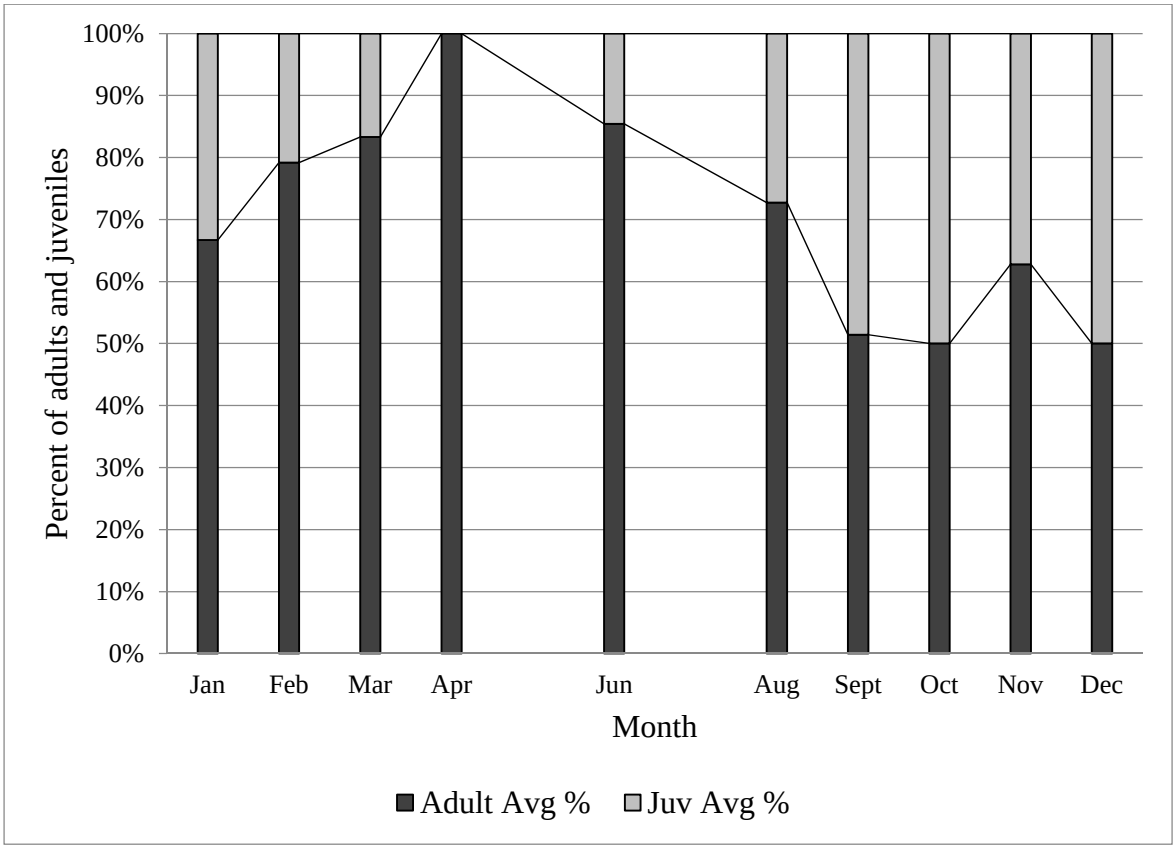

Figure 3 - Ratio of adult to juvenile Scaly-breasted Munias by month.

Flock dynamics

Flock size averages 6.1 birds/flock, (mode = 2, range = 1-30, N = 204). The largest flocks occur from mid-winter through early spring (January – March, Fig. 4). The peak observation month is March with a mean flock size of 8.8 birds. Data on unusually large flocks ($\geq$ 50 birds) were recorded in three situations, described below.

From August 2008–2011 a flock peaking at > 2000 individuals was recorded in a large grassy field in Southwest Houston. Several smaller groups comprising $\leq$ 25 juveniles and adults arrived throughout the day, accumulating into a very large mega-flock by the afternoon, and leaving during evening so that no birds remained in the area overnight.

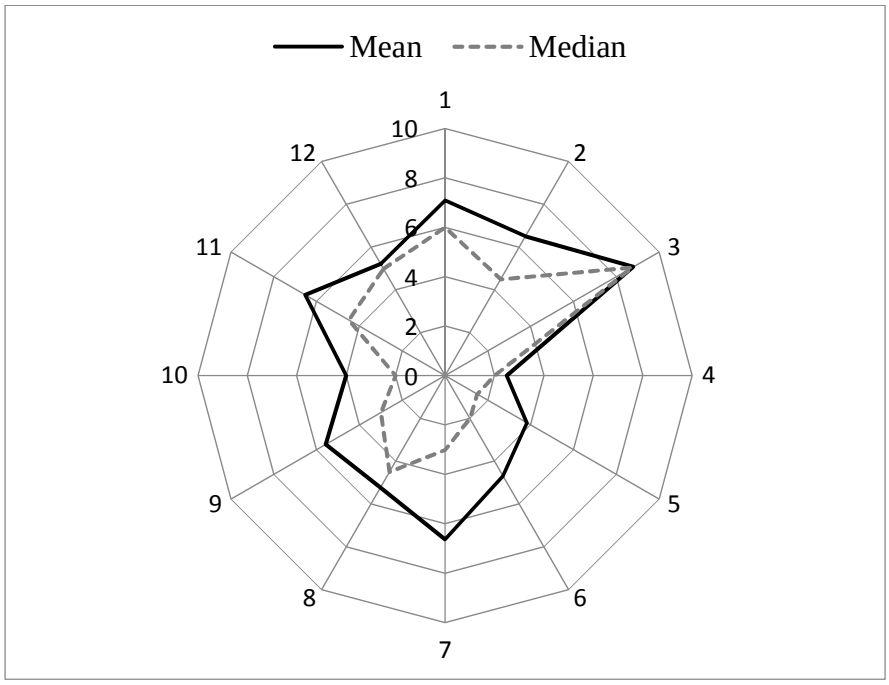

Figure 4 - Scaly-breasted Munia flock size by numeric month.

A flock of 100-150 munias living with House Sparrows (*Passer domesticus*) was observed at a suburban apartment courtyard with various trees and shrubs in West Houston from March 2011 – February 2013. In an effort to deter persistence of the flock, the feeder and plants were removed and replaced with Italian Cypress trees (*Cupressus sempervirens*) in October 2012. Despite abrupt changes to foliage and feeder removal, the flock maintained population size until a domestic cat arrived in early 2013. The two banded individuals in this flock were present until the final observation of one in late April 2012. Both banded individuals apparently bred (juveniles were observed with them) and were present year-round as non-migratory residents.

A flock of 50-70 munias was observed in a suburban backyard habitat comprised of mature oak trees, Red-tip Photinias, and Wax-leaf Ligustrums (*Ligustrum japonicum*). The flock foraged on the ground surrounding an elevated feeder, at times with other species, including: Budgerigars (*Melopsittacus undulatus*), Mourning (*Zenaida macroura*) and White-winged (*Z. asiatica*) Doves, Northern Cardinals (*Cardinalis cardinalis*), House Sparrows, and Blue Jays (*Cyanocitta cristata*), none of which were aggressive toward the munias**.**

Interspecific interactions

Munias are completely nonaggressive towards other species, and were observed foraging at feeders with 22 other species, of which seven (32%) are also introduced species (Table 1). In terms of functional guilds, these represent 12 species (55%) of primarily granivorous passerines and three species of doves (14%; Table 1).

Other species were observed foraging at feeders with munias on 96 occasions (Table 1). Species most frequently associated with foraging munias include House Finches (*Haemorhous mexicanus*) on 26 occasions (27% of all events), American Goldfinches (*Spinus tristis*) 24

occasions (25%), three species of doves (*Streptopelia decaocto*, *Zenaida asiatica*, and *Z. macroura*) 16 occasions (17%), and House Sparrows 10 occasions (10%; Table 1).

All species were mutually passive towards munias except for a single case of European Starling (*Sturnus vulgaris*), which caused munias to disperse when it approached the feeder, a behavior also elicited when Northern Cardinals approached the feeder area (Table 1). The three species of doves were occasionally agonistic at feeders, and munias would occasionally not approach feeders if House Finches or House Sparrows were present (Table 1).

Predatory species such as hawks are rarely seen in the vicinity of feeding munias. A single Cooper's hawk (*Accipiter cooperii*) was observed during two consecutive days at the same site, and a single Red-shouldered hawk (*Buteo lineatus*) was seen once. Although these raptors elicited no response from the munias, a single hawk (species unidentified) caused the munias to disperse once.

Table 1 - Species that are passive and agonistic towards Scaly-breasted Munias (*Lonchura punctulata*) when feeding

Common Name	Latin Name	N	Passive	Agonistic
dove (unspecified)		13	X	X
Eurasian Collared Dove[1]	*Streptopelia decaocto*	1	X	
White-winged Dove	*Zenaida asiatica*	1	X	
Mourning Dove	*Zenaida macroura*	1	X	
Budgerigar[1]	*Melopsittacus undulatus*	2	X	
Blue Jay	*Cyanocitta cristata*	1	X	
Black-capped Chickadee	*Poecile atricapillus*	1	X	
Tufted Titmouse	*Baeolophus bicolor*	1	X	
Eastern Bluebird	*Sialia sialis*	1	X	
Northern Cardinal	*Cardinalis cardinalis*	4	X	X[2]
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	1	X	
Chipping Sparrow	*Spizella passerina*	1	X	
Savannah Sparrow	*Passerculus sandwichensis*	1	X	
White-throated Sparrow	*Zonotrichia albicollis*	1	X	
Song Sparrow	*Melospiza melodia*	1	X	
Red-winged Blackbird	*Agelaius phoeniceus*	1	X	
European Starling[1]	*Sturnus vulgaris*	1		X[2]
House Finch	*Haemorhous mexicanus*	26	X	X[3]
American Goldfinch	*Spinus tristis*	24	X	
House Sparrow[1]	*Passer domesticus*	10	X	X[3]
Orange-cheeked Waxbill[1]	*Estrilda melpoda*	1	X	
Bronze Mannikin[1]	*Lonchura cucullata*	1	X	
Pin-tailed Whydah[1]	*Vidua macroura*	1	X	
TOTAL	**22 species**	**96**		

[1] Introduced

[2] Munias sometimes flew away when this species arrived

[3] Munias sometimes waited until this species left feeder before feeding

Activity patterns

The most frequent behaviors are foraging/feeding (n = 210), calling/vocalizing (n = 130), and perching/resting (n = 86; Fig. 5), which account for 78% of observed munia activity.

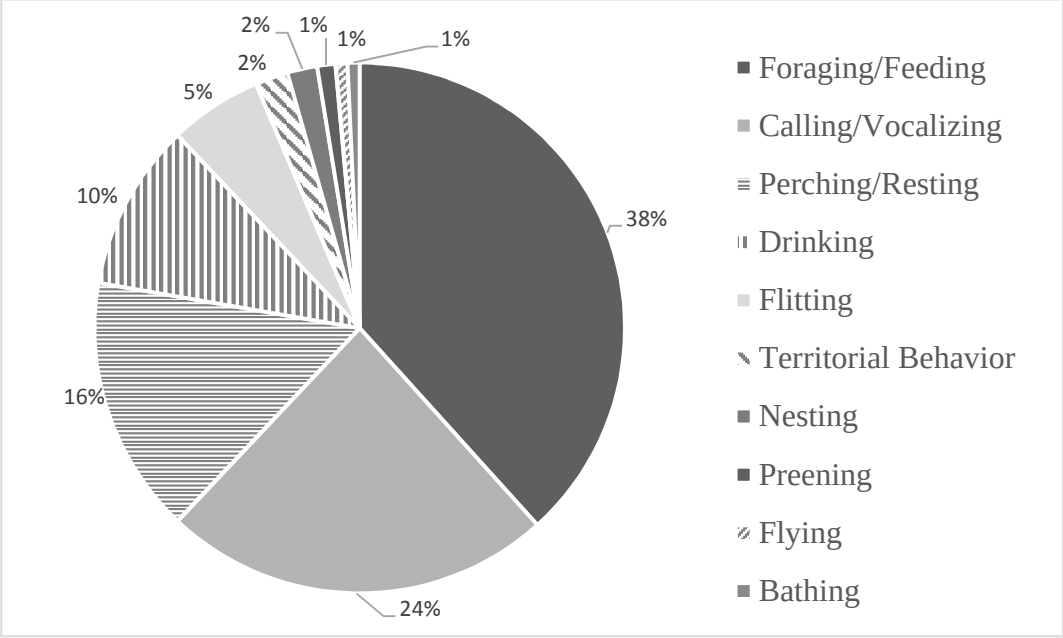

Figure 5 - Scaly-breasted Munia frequency of observed activity pattern in Houston, Texas.

Foraging at birdseed feeders is the most frequent mode of foraging (n = 141 observations, 67%, N = 210). In terms of location at the feeder, feeder perches (n = 131, 93%) are used significantly more than ground-foraging at feeders (n = 10, 7%; X^2 = 102.85, df. = 1, P = 0.0001). Other records of food items include (n = 1 each unless otherwise noted): unspecified grass (n = 5), Bristle grass (*Setaria sp.*), Johnson grass (*Sorghum halepense*), Chinese pampas grass (*Miscanthus sinensis*), garden weeds, Hungarian broom corn (*Sorghum sp.*), sunflowers (*Helianthus sp.*; n = 2), and tree buds. Feeders are also the most frequently observed abiotic perch (84%, N = 38, Table 2).

Munias perched on 25 species of plants (Table 2). The most frequent species for perching are oak trees (*Quercus sp.*, n = 7) and crepe myrtle (*Lagerstroemia sp.*, n = 4). Of the 25 species of plants perched on, 60% (n = 15) are native to Texas, 24% (n = 6) are exotic species (primarily trees and shrubs) from within the range of the munia, and 16% (n = 4) are exotic species (primarily grasses) from outside the range of the munia (Table 2). Munias significantly preferred perching in native Texas vegetation than plants species introduced to Texas (X^2 = 4.16, d.f. = 1, P = 0.04). Mean perch height is 2.86 m, and the number of individuals (n = 21) that perched low in the tree (<5 m high) is significantly greater (X^2 = 48.21, d.f. = 1, P = 0.0001) than the number (n = 6) perching high (>5 m).

Table 2 - Biotic and abiotic perches of Scaly-breasted Munia (*Lonchura punctulata*)

Latin Name	Plant/Object	Origin	N	Height (m)	≤5 m	>5 m
Salix sp.	Willow	N	1	1.07	1	
Pinus sp.	Pine	N	3	3.5	1	
Quercus sp.	Oak	N	4	4.5	1	
Quercus nigra	Water Oak	N	2	0.61	1	
Quercus virginiana	Live Oak	N	1	3.05	1	
Lagerstroemia sp.	Crepe Myrtle	EM	4	0.3	1	
Magnolia sp.	Magnolia	EM	2	7.62		1
Morus sp.	Mulberry	EM	1	3.96	1	
Carya illinoinensis	Pecan	N		2.13	1	
Pyrus communis	Pineapple Pear Tree	N	1	1.8	1	
Ilex vomitoria	Yaupon	N	1	3.96	1	
Vitex agnus-castus	Lilac Chastetree	EO	1			
Myrica cerifera	Wax Myrtle	N	1	3.05	1	
	dead tree		2	3.35	1	
Nerium oleander	Oleander	EM	1	2.74	1	3
Helianthus argophyllus	Silver-leaf Sunflower	N	1			
Helianthus sp.	Wild Sunflower	N	1	1.82	1	
Setaria sp.	Bristle Grass	N	1			
Hibiscus sp.	Hibiscus	EM	1	0.3	1	
Saccharum sp.	Cane	N	1			
Gossypium sp.	Cotton	N	1		1	
Ipomea sp.	Morning Glory	N	1		1	
Photinia x fraseri	Red-tipped Photinia	EM	1			
Sorghum halepense	Johnson Grass	EO	1		1	
Sorghum vulgare	Hungarian Broom-corn	EO	2	1.68	1	1
Miscanthus sinensis	Japanese Pampas Grass	EO	1	1.07	2	1
	Abiotic Perches					
	fencepost		1	1.82	1	
	feeder		32	1.3	1	
	birdbath		5	0.03	1	

N = Native Texas plant
EM = Exotic plant whose native range lies within the native distribution of the munia
EO = Exotic plant whose native range lies outside the native distribution of the munia

DISCUSSION

Comparisons with Munias in their native range

In their native range munias are found from 0 - 3000 m in scrubby grassland, rice paddies and other crops, forest edge, parks, and gardens (Clement et al. 1993, Payne 2010). Most Houston munias are observed in residential gardens, with the only other cases being populations in more rural parkland. Moreover, populations appear to be moving towards increasingly urban areas inside the city (Fig. 2). These results support the model of invasive species succeeding in human-altered environments where ecological niches are available that remain unexploited by native species (c.f., Lockwood et al. 2007).

Munias breed from April - June in regions such as Indonesia (Verheijen 1964), although they can breed during any month of the year considering the global natural population (Restall 1997, Payne 2010). Houston munias bred from April – September, reflecting the more temperate location of this population. The globose nests are typically found in trees and bushes 4-13 m high (Payne 2010). While the shape and architectural attributes of the nest for Houston munias are similar to the description of Payne (2010), the overall height of the nest in the tree is lower, never exceeding 4 m in height.

Clement et al. (1993) indicated munias are highly social, and frequently found in small flocks, although flocks of up to several hundred may occur. Similarly, Houston munias typically ranged in small flocks $\leq$ 25 individuals, although three much larger flocks were recorded. Benefits of group foraging, particularly decreased vigilance and enhanced seed search and handling time, often increase with flock size (Beauchamp et al. 1997).

Munias are present year-round in Houston, confirmed by the presence of two banded individuals for > 1 yr. Clement et al. (1993) also stated that munias are year-round residents in their native range. Two banded individuals recovered at 5 and 17 km in the Malay Peninsula suggest there may be very local seasonal movements tracking grain crop blooms (Payne 2010), however in Texas munias are not found in rural crop monocultures.

Munias are specialists of seeding grasses (Clement et al. 1993, Restall 1997, Payne 2010). Payne (2010) provided a list of several species of seeds consumed and indicated that *Spirogyra* algae and small insects may be taken as well. Similarly, Houston munias are observed foraging in various grasses (exclusive of offered bird seed) in most foraging observations.

Houston munias used a diverse array of plants as perches, and significantly preferred perching in native Texas vegetation than plants species introduced to Texas, including six species found in their natural range. These findings corroborate those of Sharma et al. (2004) that munias in India adapt quickly and successfully to urbanized habitat, and prefer nesting in introduced trees in urban areas more than native trees in natural habitats.

Comparisons with other introduced populations of Munias

As with Houston munias, other introduced populations are found in residential areas, including Florida (Duncan 2009), California (Smithson 1997; Garrett 1998, 2000), and Australia (Whatmough 1981, Jones and Wieneke 2000). Although fewer Houston munias are found in urban parks and flood basins, these habitats are also shared with munias in Hawaii (Moulton et al. 1992) and California (Smithson 1997, Garrett 1998). While Collins (2015) noted a proclivity for drainage ditches and retention ponds, these habitats were only recorded for Houston munias on four and two occasions, respectively.

Nesting in California is noted from February - November (Smithson 1997), whereas in Houston munias bred from April - September. Houston munias nested in tree species from their native range, as well as species of trees from Texas and Europe. In California most nests are in pine trees, but also in other exotic species of trees (Smithson 1997). While the nest structure is similar

between California (Garrett 1998) and Houston munias, in California the mean nest height is overall higher than in Houston.

In contrast to Houston munias, those in Oahu are more common during summer than winter due to more resources available during summer (Moulton et al. 1992). Nonetheless naturally occurring populations of munias are year-round residents, concordant with the finding of Clement et al. (1993).

As is the case with munia populations in Houston, those in Hawaii (Moulton et al. 1992) and California (Smithson 1997) fed exclusively on grass seeds, as well as commercial bird seed provided at feeders (Garrett 1998).

Are introduced Munias a threat in Houston?

In southeast Asia munias are known as 'rice birds' and are used by Buddhists for religious purposes (Clement et al. 1993). In Houston they are often used during Asian religious ceremonies such as weddings, where large numbers of the birds are released instead of throwing rice (Collins 2015). It is probable that munias in other parts of the state are the result of similar releases.

The introduced populations may be cyclic, where numbers will build up only to decline during a hard freeze (Restall 1997). Duncan (2009) noted that the population in Pensacola, Florida has survived at least two Category 3 hurricanes with winds nearly 200 km/hr, as well as several freezes, including temperatures below 0^0 C. Pensacola is about 1^0 north of Houston, and has fairly mild winters, often freezing only once or twice per winter for $\leq$5 hr/night. Consequently, the deaths due to freezing described by Restall (1997) do not occur in Houston and the population is likely expanding.

Long (1981) suggests invasive munias could be a serious threat to numerous species of endemic Estrildid finches, especially in Australia. In Houston however, there are no native Estrildid finches or other avian species with a similar niche (i.e., small granivore occupying weedy fields low to the ground), perhaps part of the reason the munias are so successful in this region. Agonistic aggression was never witnessed towards other species at feeders in Houston, likely owing to the small size and non-aggressive nature of the munia.

Historically munias in their native range were considered primarily rice and other grain crop pests in China, India, and the Philippines (Ali 1953, Cheng 1963, Long 1981). Although munias were formerly considered a pest on rice and sorghum crops in Hawaii (Caum 1933, Hawaiian Audubon Society 1975), this is no longer the case since these crops are not grown as frequently (Long 1981). While Garrett (1998) identifies munias as a potential grain pest threat in California, he provided no data to demonstrate this. Moreover, other introduced munia populations are not currently identified as a potential threats (e.g., Eguchi and Amano 2004, Duncan 2009, Pranty 2011). In Houston, munias are mostly restricted to residential regions and none are observed in monocultures of grain crops. Therefore, it is unlikely that munias could be currently considered an agricultural grain pest.

Munias have not exploded in other regions of the state, and closely related species such as Bronze Mannikin (*L. cucullata*) are not nearly as abundant and have already experienced a population

crash since the publication of Brooks and Page (2012, Brooks unpubl. data). Houston munias are not known to outcompete populations of native birds, or deplete native plants for consumption. The leading factors attributing to the success of *L. punctulata* in the Houston region are likely non-prolonged freezing temperatures combined with the prevalence of feeders (Brooks and Page 2012). Diminishing the number of active feeders would likely diminish expansion of the current munia population.

Careful monitoring has been recommended for other invasive species in the region (e.g., Callaghan and Brooks 2016). Although it appears that the introduced Houston munia population is not currently a threat, they should be closely monitored in light of potential grain pest issues.

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Show me the money!

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Avitourism (birding tourism) is a Texas original, like "Don't Mess With Texas", Aggie jokes, and Big Tex. Texas didn't invent birding (although the American Birding Association began in our state in 1968), but avitourism is as Texan as Willie Nelson and all-hat-and-no-cattle cowboys.

In 1993, Paul Kerlinger, Dick Payne, and I published an article in Birding titled "High Island: A Case Study in Avitourism". I fabricated the word "Avitourism". I thought that birding tourism sounded too plain, too pedestrian, too unscientific. I wanted to be taken seriously, and I needed a puffed-up word that sounded serious as well. Avitourism seemed just inflated enough.

Earlier that spring (1993), I had presented a paper on the ecotourism opportunities in Galveston. The two publications attracted the attention of Texas Parks and Wildlife. Then-director Andy Sansom invited me to join a task force being appointed by Governor Ann Richards to develop a nature tourism strategy for the state.

Our planning efforts were getting underway in late 1993 when Watchable Wildlife met in Corpus Christi. Late in the conference (lubricated by a few timely glasses of wine), Madge Lindsay and I began to consider implementable recommendations that could be woven into the state strategy. Madge mentioned her contact with the new ISTEA (*Intermodal Surface Transportation Efficiency Act*) enhancement program, I mentioned my idea of a birding trail, and two years later (1995) we joined Roger Tory Peterson in Rockport to dedicate the first section of the world's first birding trail – the Great Texas Coastal Birding Trail. Around the same time, Kerlinger and I published "Birds and Bucks" in Birding as well.

Birders and conservationists didn't talk much about the economic impact of birding in those days. Our article in Birding joined a handful of previous attempts to quantify the contributions made by birders to local economies. But our efforts to organize a state nature tourism strategy catalyzed (at least for us) the idea that birding, as a recreation, might serve economic as well as conservation interests.

The Great Texas Birding Trail led to the Great Texas Wildlife Trails which led to the World Birding Center (WBC) which led to communities throughout the state investing in lands and facilities for birders. I worked on many of these projects. At times, we took two steps forward then one back, but all of us progressed. The communities invested, Texas Parks and Wildlife and other federal and state agencies invested, and birders, attracted to the new facilities, invested as well.

Nowhere is this progress more clearly seen than in the Lower Rio Grande Valley (Valley) of South Texas. I began birding in the Valley in the late 1960s. Both Santa Ana NWR and Bensten

SP were relatively undeveloped for birding then, with tiny visitor centers (in Santa Ana's case, Wayne Shifflett's home) inside the flood levies.

Estero Llano Grande State Park, Frontera Audubon Society's sanctuary in Weslaco, the Valley Nature Center, the Lower Rio Grande Valley NWR, Quinta Mazatlan, TNC's Chihuahua Woods Preserve, Edinburg Scenic Wetlands, the Old Hidalgo Pumphouse, the Hugh Ramsey Nature Park in Harlingen, Resaca de las Palmas State Park, the South Padre Island (SPI) Convention Center woodlands and boardwalk, and the SPI Birding and Nature Center did not exist. Audubon kept the Sabal Palm Sanctuary closed for much of the time.

Agriculture still dominated the Valley, with limited food and lodging for birders (the La Quinta Inn and Luby's Cafeteria in McAllen would become famous for that reason) and even less habitat for birds. Birds once common in the Valley such as White-collared Seedeater, Aplomado Falcon, and Gray-crowned Yellowthroat were gone. Many of the specialties (Green Jay, Altamira Oriole, Plain Chachalaca, Brown-crested Flycatcher) were seen only in the few parks and refuges.

The Great Texas Coastal Birding Trail (Trail) changed all of this. I know of few places in the world where birding has been better nurtured, developed, and embraced by the local communities. No, the Trail didn't do this alone. But the Trail did provide a platform for future action, and a context for community involvement. Without the investment and commitment by Valley communities, nothing would have been accomplished at the scale of what you see today.

Consider the investment in the World Birding Centers alone. Texas Parks and Wildlife, with funding provided by the legislature (and promoted by local elected officials) developed Bentsen-Rio Grande Valley SP, Estero Llano Grande SP, and Resaca de las Palmas SP. State funding, bolstered by local community matches, sponsored the Edinburg Scenic Wetlands, McAllen's Quinta Mazatlan, Harlingen's Arroyo Colorado (Hugh Ramsey Park), Hidalgo Pumphouse, and the South Padre Island Birding and Nature Center. The US Fish and Wildlife Service made the WBC in Roma possible. The WBC is now comprised of nine separate birding destinations, and all of the planned enhancements are finished.

Without funding from federal and state agencies, as well as the investments of the local taxpayers, none of this would have been possible. Is it worth it? Did the taxpayers get a reasonable return on their investment?

Birders would answer an emphatic yes. But what about nonbirders? No doubt the projects have benefited the birds, but where is the money? Show me the money!

Kerlinger, Payne, and I estimated that in the early 1990s the refuges in the Valley contributed around $60 million to the local economies in direct expenditures. We later included indirect and induced impacts (a multiplier) and we estimated an overall impact of around $125 million annually. Local communities used that number for years, and, at times, we were questioned as to how birders could possibly contribute so much to the local economy. To be blunt, we were grilled.

Now another estimate has been proffered, this one by researchers at Texas A&M. According to them, nature tourists (birders, bird people, butterfly people, dragonfly people, and the like) now contribute over $300 million to the local economy each year.

According to this report, estimated total annual expenditures by intentionals (based on off-peak visitation) for 2011 were $300,090,886. This direct economic contribution from RGV nature tourism led to a total county-level economic output of $344.4 million and 4407 full and part-time jobs annually. This total contribution includes a $179.4 million contribution to gross regional product and a $110.1 million contribution to labor income across the region. Local taxes generated from direct nature tourist expenditures for 2011 were $2,595,600 for sales tax and $7,262,700 for hotel tax.

Nature tourism is a job creator in South Texas, and conservation is a side benefit. Why would government, if concerned about job creation, threaten the funding that made such jobs possible?

Let me be clear. Federal and state funding does not directly support these nature tourism jobs. Governmental funding enables the private sector to create the jobs, much like airports and highways do. The highway department funds the construction of roads, and the private sector uses these roads to move people to work and products to customers. The Federal Avian Administration does not ship goods, they fund the airports that enable the private sector to ship freight and travel to jobs and prospects.

Public sanctuaries, refuges, and parks are destinations, not providers. Birders travel to Santa Ana NWR to see green jays and chachalacas, but they stay in local hotels such as the Alamo Inn and eat in local restaurants. Private resorts (Club Med, cruise ships, Disney) have no incentive to spread dollars outside of their properties. They work to fence in every cent. Public lands capture little economic return within the park or refuge boundaries (and get blamed for losing money). Travel expenditures are distributed throughout the region, helping local communities benefit from the visitation.

For years, I quoted Francis Cairncross from her book Costing the Earth. She said that "in a world where money talks, the environment must have value to give it a voice". I thought that we had progressed past that point where we needed to label every resource with a dollar value. I stopped quoting her years ago.

No longer. She is right, and I am wrong. Birding has proven its point. The lands protected for birds generate jobs and taxes. These same lands attract wildlife viewers, hunters, hikers, bikers, campers, anglers, and the like, and they too spend money to recreate. The government invests a little, and communities and small businesses benefit a lot.

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NEOTROPICAL ORNITHOLOGY

Owl community description in the Napo Basin drainage, Peruvian Amazon

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Abstract - We provide community description of owls in the Napo Basin drainage (Peruvian Amazon), based upon ~70 sampling nights. Seven species (65 individuals) were recorded: four species more abundant during high-water season, and one (*Lophostrix cristata*) more abundant during low-water. Numerically dominant species include *Megascops choliba* and *Glaucidium brasilianum*, with *Pulsatrix perspicillata* abundant to a lesser extent. All seven species were accounted for by the ninth (out of 12 total) sampling durations, and no new species were recorded 17 years after initial core sampling. All seven species were recorded in *terra-firme* rainforest, and four were also associated with Igapo. All but one individual *P. perspicillata* was recorded by audio detection; five individuals were visually located after being recorded auditorily. Results are compared with a similar study from the central Amazon Basin.

Documenting species presence or absence is the most basic fundamental requisite of biological inventory (e.g., Brooks et al. 2009). For some taxa (e.g. Owls, Family Strigidae), such inventories are extremely limited due to the secretive nocturnal habits of this family (Enriquez-R. and Rangel-S. 2001, Borges et al. 2004). However, experienced knowledge of vocalizations among different species facilitates an efficient means for sampling owls in any given region.

There are few community ecology studies of Amazonian owls. A study in the central Amazon Basin of Brazil focused on density and habitat use (Borges et al. 2004). At the study site described below in the Napo drainage region, owl populations have been shown to be relatively stable without showing significant increases or declines over time (Brooks et al. 2005) and assemblages are not structured by size assortment or adjustment (Brooks 1998).

Herein we describe the owl community in the Napo Basin drainage from approximately 70 sampling nights in the Peruvian Amazon. We provide information on species abundance, habitat association and compare sampling procedures (nocturnal audio sampling versus diurnal visual sampling). We also discuss comparisons with a similar study in the central Amazon Basin.

METHODS

The study site was located in the Napo-intersect region, where the Napo River drains into the Amazon River in Peru (Fig. 1). Mean annual temperature in the region is 26 C^{o}, ranging from 22 C^{o} in July to 31 C^{o} in November (Salati 1985), with annual rainfall ranging 2500 - 3000 mm per year (Johnson 1976, Brooks pers. obs.).

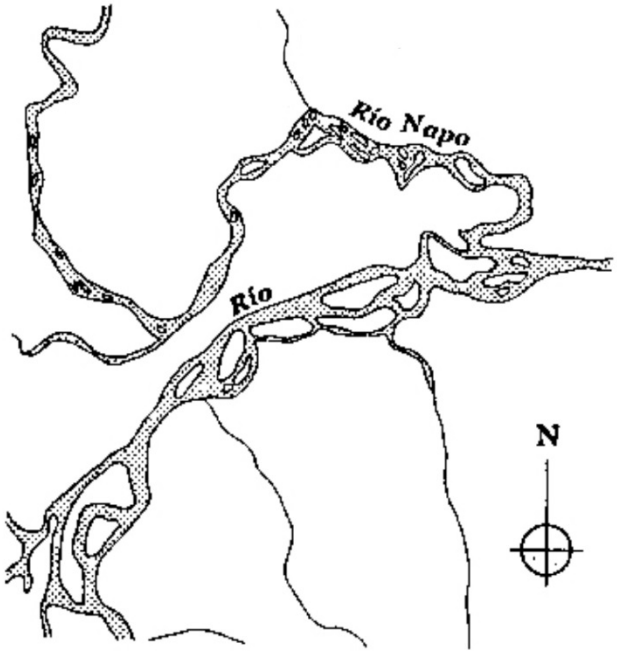

Figure 1 - Study region in the Peruvian Amazon.

Most sampling was done using point-counts staged within 1 km at each of three jungle lodges: Explorama Lodge on the Yanamono Tributary off the Amazon (3º26'30"S, 72º50'56"W), ExplorNapo Camp on the Sucusari Tributary off the Napo (3º15'50"S, 72º55'15"W) and ACEER (Amazon Center for Environmental Education and Research) located further up and inland of the Sucusari (3º14'57"S, 72º54'32"W). The primary habitat surrounding all three jungle lodges was lowland riverine tropical rainforest (hereafter *terra-firme)*, with a tributary included within each of the three core sampling areas. Several species of palms (e.g., *Euterpe* sp., *Mauritia flexuosa*, *Scheelea* sp., *Socratea* sp.) and taller trees that often form part of the canopy, buttresses, or canopy emergents (e.g., *Cedrela* sp., *Ceiba pentada*, *Ficus insipida* and *Inga* sp.) represent some of the dominant species (Remsen and Parker 1983).

Sampling took place six sessions each during terminal periods of low-water (primarily during the month of October 1993-98) and high-water seasons (primarily during May 1995-98, as well as early June 2003 and mid March 2015). While the core sampling was accomplished 1993-98, the two later dates (2003, 2015) permitted us to determine if significant changes took place five and 17 years, respectively, from the last core sample.

Owls were auditorily sampled nocturnally from nightfall until 21:00 hrs and from 04:00 hrs until dawn, with some periods between 21:00 - 04:00 hrs sampled *ad-libitum*. Data throughout the night were pooled since calling patterns did not vary significantly regardless of sampling time. Selected voucher recordings were deposited in the Bioacoustics Laboratory at Texas A&M University.

To analyze whether owls were found exclusively in *terra-firme*, several nocturnal surveys were also conducted in blackwater flooded forest (hereafter Igapo) at Casares Lake (26 May 1996, 23 March 1997) and Shumay Lake (16 March 2015).

To determine whether diurnal surveys were feasible for sampling owls visually, diurnal transects were performed in a variety of habitats; details were reported elsewhere (e.g., Brooks 1998). Generally, data were collected on species presence and abundance using strip transects, recording birds that could be accurately detected using unlimited distance contacts (Ralph 1981). Walked transects were complemented with some boat transects because waterways, as opposed to trails, are the primary path for transportation in this region (Brooks *et al*. 1999). An effort was made to use several transects in each habitat to reduce the risk of over- or underestimating species abundances due to higher or lower yields along certain transects (Brooks and Begazo 2001).

RESULTS

Four of the owl species were more abundant during high-water season, and only one (*Lophostrix cristata*) was more abundant during low-water (Table 1). Since all species of owls were aseasonal, we pooled season data together for analyses.

Table 1 - Total (upper bold value) and mean/N sampling durations (lower) for Owls in *terra-firme* (Napo drainage)

OWL SPECIES	LW	HW-E	HW-L	TOTALS
Tropical Screech Owl*	**7**	**12**	**4**	**23**
Megascops choliba	1.16	3	2	
Tawny-bellied Screech Owl	**2**	**1**	**1**	**4**
M. watsonii	0.33	0.25	0.5	
Crested Owl	**3**	**0**	**1**	**4**
Lophostrix cristata	0.5	0	0.5	
Spectacled Owl*	**3**	**5**	**1**	**9**
Pulsatrix perspicillata	0.5	1.25	0.5	
Ferruginous Pygmy Owl*	**7**	**12**	**3**	**22**
Glaucidium brasilianum	1.16	3	1.5	
Black-banded Owl*	**1**	**0**	**1**	**2**
Ciccaba huhula	0.16	0	0.5	
Mottled Owl	**0**	**1**	**0**	**1**
C. virgata	0	0.25	0	
TOTALS	**23**	**31**	**11**	**65**

* = Also recorded in Igapo
LW = Low-water season, HW-E = High-water season - early (1995-98),
HW-L = High-water - later (2003, 2015).

A total of seven species of owls represented by 65 individuals were recorded (Table 1). The dominant species by far were *Megascops choliba* (N = 23) and *Glaucidium brasilianum* (N =22), with < 5 individuals recorded for the other species except for *Pulsatrix perspicillata* (N = 9, Table 1). Despite the abundance of smaller species, body size was not necessarily inversely correlated with abundance, as the third most frequently recorded species (*P. perspicillata*) was also the largest.

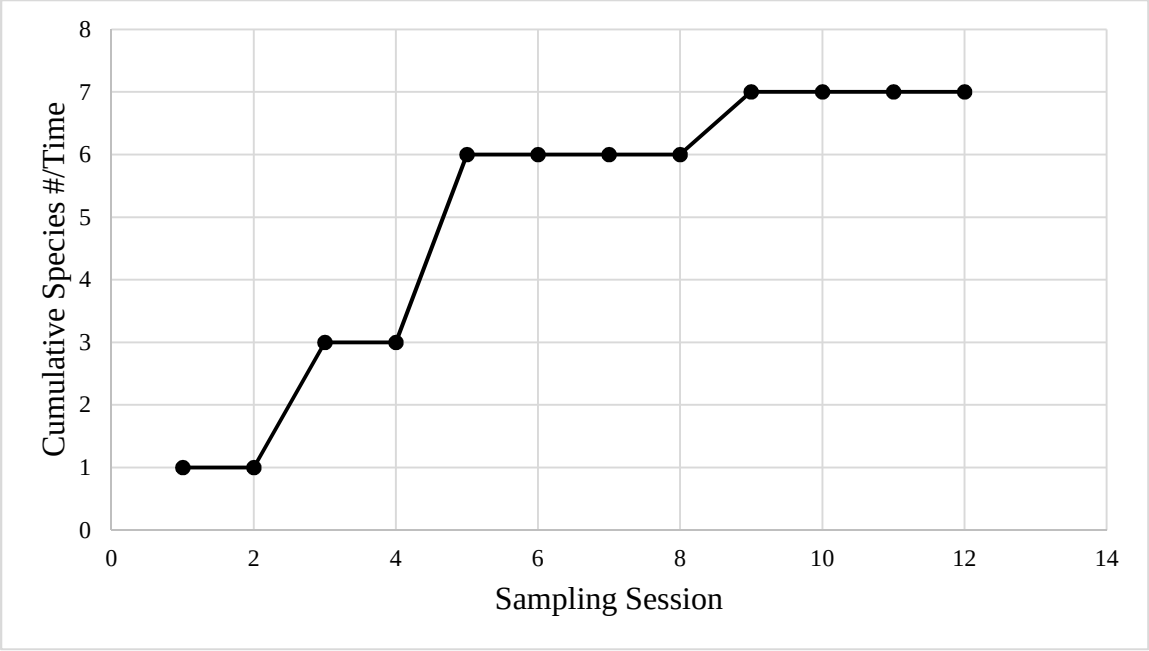

Figure 2 – Cumulative species richness of sympatric Amazonian owls (Napo R. drainage, Peru).

Six species were accounted for by the fifth sampling session, and the community plateaued with seven species after the ninth session (Fig. 2). Despite most of the sampling taking place from 1995-98 (n = 10 sessions), no new species were recorded during 11th and 12th sampling sessions, five and 17 years later, respectively (Table 1).

All seven species were recorded in *terra-firme*. Four of these species (*Megascops* choliba, *Pulsatrix perspicillata*, *Glaucidium brasilianum* and *Ciccaba huhula*) were recorded in Igapo during the few samples that were accomplished.

All individuals except for one were recorded strictly by audio detection at Explorama Lodge. A single *Pulsatrix perspicillata* was recorded visually during the day along a transect, it flew approximately 50 m from DMB just inland from the Sucusari Tributary on 26 March 1997. The owl was silent during its short flight in the rainforest and would have been completely missed if DMB was not looking in its direction. Five individuals were visually located after being audio recorded: three *Megascops choliba* (two different individuals late May 1996, one in early June 2003), and singletons of *P. perspicillata* and *Ciccaba virgata* during late May 1996.

DISCUSSION

Approximately 1200 km straight east of our study site is Jau National Park, Brazil located in the central Amazon Basin. At this site a similar study was undertaken by Borges and his colleagues (2004), which is useful for comparison. Using point-counts with audio playback, Borges et al. (2004) registered six species (81 individuals) of owls in five nights of sampling during low-water season 1994, and 12 nights of sampling during high-water season 1995.

Species composition was similar, except Borges et al. (2004) did not record *Lophostrix cristata* or *Ciccaba virgata*, but did record *Asio stygius*, a species not recorded during our study. While

Megascops choliba and *Glaucidium brasilianum* were the numerically dominant species in both studies, the third most abundant species in Borges et al. (2004) was *M. watsonii*, although *Pulsatrix perspicillata* was recorded the same number of times (N = 9) in both studies, as was a rarer species, *C. huhula* (N = 2). The numbers of *G. brasilianum* recorded were also similar (22 in Peru, 25 in Brazil; NS X^2 test, P = 0.83). While the differences between numbers of *M. choliba* were also not significant (23 in Peru, 32 in Brazil; X^2 test, P = 0.44), this was clearly not the case for *M. watsonii* (4 in Peru, 21 in Brazil; X^2 test, P = 0.01). The differences in species composition and numeric dominance are subtle, likely owing to the proximity of the two study areas relatively similar habitat.

While all six species of owls were recorded in Igapo in Borges et al. (2004), only four of these six were found in *terra-firme* in their study. With the exception of *Megascops watsonii*, all of the species we recorded in Igapo were also found in Igapo in Borges et al. (2004). It is possible that the rarer status of *M. watsonii* at our study site led to us not detecting it in Igapo, or that increased sampling effort in Igapo would have led to more individuals of this species being detected in the Napo drainage. The situation could be similar for *Asio stygius*, another species Borges et al. (2004) only recorded in Igapo but we did not record in our study, perhaps due to too limited sampling effort in Igapo. The other species not found in *terra-firme* in Borges et al. (2004) was *Glaucidium brasilianum*, which was quite abundant in *terra-firme* in our study. The reason for this may be due to simple Beta-diversity level geographic turnover in habitat association.

Audio detection (n = 64) was clearly more efficient than visual sampling (n = 1; X^2 test, P = 0.0001). While this was not surprising (Ralph 1981, Bibby et al. 1997), the degree of inefficiency of visual sampling was, in light of the number of owls that are observed and photographed diurnally by birdwatchers, naturalists and photographers. For example, over 9000 owl photographs were documented by nearly 3000 participants in iNaturalist (2017).

While four of the species more abundant during high-water season, *Lophostrix cristata* was more abundant during low-water. The reasons for this are unknown, whether it was bias due to a limited sample size or if *Lophostrix* undertakes seasonal movements, preferring better drained forest than the converse. Situations such as this 'gap in knowledge' point to the need for more detailed studies (e.g., involving radio-telemetry) to uncover the most basic elements of ecology and natural history for the secretive and furtive tropical forest owls, such as those dwelling in the Amazon Basin.

ACKNOWLEDGMENTS

We are indebted to CONEPAC and INRENA for permission to work in the region. Logistical support was provided by Explorations, Inc. and the late Peter Jenson of Explorama. This manuscript is dedicated to Dr Keith Arnold, who has always been extremely interested in owls, and advised Brooks (1998) on his Ph.D. research at the study site in this ms.

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Habitat use, sympatry and competition in Carolina (*Thryothorus ludovicianus*) and Spot-breasted (*Pheugopedius maculipectus*) Wrens

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Abstract - Habitat use by Carolina Wren (*Thryothorus ludovicianus*) is poorly known in subtropical and tropical portions of its range, much of which it shares with Spot-breasted Wren (*Pheugopedius maculipectus*). We documented similar use by Carolina Wrens of mature and revegetated woodlands and urban woodlots in the Lower Rio Grande Valley of Texas. In Tamaulipas, Mexico, Carolina Wrens were limited to canyons and lower montane slopes, while the more widespread Spot-breasted Wren also occurred in lowland riparian forest. In the Yucatán Peninsula, both wrens co-occurred in many forested areas, while Spot-breasted Wrens occurred more in semi-open, disturbed roadside areas and dense forests and thickets. We documented successful breeding by the Carolina Wren at one location in Yucatán state.

The Carolina Wren (*Thryothorus ludovicianus*) is a common, well-known, permanent resident of eastern and central North America. Its song (given year-round) is a prominent feature of well-vegetated suburban residential areas and wooded parks in much of its range. The species nests in cavities, nest-boxes, crevices in stone walls or building, or other small manmade hollows (Haggerty and Morton 2014). This species is well-known for extending its northern range limits during milder winters and retreating back south when colder winters occur (Arnold 1956, Haggerty and Morton 2014).

Although the Carolina Wren's range extends into subtropical and tropical areas of southernmost Texas, Mexico, and northern Central America, its habitat use, nesting status, and interactions with other wrens are much less well known. This study summarizes field work in the Lower Rio Grande Valley of Texas (LRGV) in May-June 2013 and 2014 and occasional field trips (mainly in January, May and June) to selected areas of Tamaulipas and the Yucatán Peninsula in 2001-2015.

STUDY AREAS AND METHODS

Field work in the LRGV (Fig. 1) was conducted as part of a study of the effects of habitat restoration on woodland birds in 2013 and 2014 (Brush and Feria 2015). We performed point-counts of birds mainly in mature (56) and revegetated (31) woodlands along and near the lower Rio Grande, and we also did point-counts on a more limited basis in urban woodlots (7) and well-vegetated suburban residential areas (7). Each count was surveyed once in May and once in June during both years. We also obtained habitat data centered on each point, and analyzed the bird and vegetation data using partial least-squares regression and principal components analysis (details in Brush and Feria 2015).

We opportunistically studied Carolina Wren habitat use and occurrence while conducting general ornithological field work in Tamaulipas and the Yucatan Peninsula of Mexico (Fig. 1) episodically from 2001-2015. We also recorded numbers and habitat use of Spot-breasted Wrens (*Pheugopedius maculipectus*), a possible competitor. Nearly all observations of both species were of birds singing their distinctive songs (Howell and Webb 1995), and we occasionally glimpsed birds in the dense foliage. We typically detected 1-3 singing individuals, occasionally up to 7 birds, of a particular species in an area.

Figure 1 - Location of study areas. Actual sites are specific locations within the boxes (see text).

We made 2-4 day visits to Tamaulipas in June 2003, January and June 2006, May and June 2007, May and July 2008, and January 2010. We spent most of our time in riparian forest and adjacent scrub, the coastal plain and lower montane slopes near Ciudad Victoria and Gomez Farías (details on study areas in Brush 2009). Typically mornings were spent investigating one or two areas thoroughly, and we used late afternoons to scout area for the next day, or observing roadside areas.

We made 4-7 day visits to the Yucatán Peninsula in January 2009, May 2011, May 2012, May 2013, May-June 2014, and May-June 2015. Observations in the Yucatan Peninsula were primarily made at Mayan historic sites (mornings), where trail networks usually allowed good access to wooded areas, with clearings of various sizes around the ruins (Brush and Brush unpubl.

data). We also observed birds along roadsides in various mixtures of woodland, scrub, and agricultural habitats, mainly during late afternoons.

RESULTS

Texas

Lower Rio Grande Valley - Carolina Wrens occurred on roughly 33% of census points in both mature and revegetated woodlands, as well as in urban woodlots, but were not recorded in residential areas (Table 1). In the better-surveyed mature and revegetated woodlands, Carolina Wrens were most strongly associated with taller, moist riparian forest, with abundant foliage at 4-6 m, and cedar elms (*Ulmus crassifolia*) and vines present. Texas persimmon (*Diospyros texana*) and tepehuaje (*Leucaena pulverulenta*) trees were also more moderately associated with Carolina Wren presence. Such habitat occurred primarily at Santa Ana National Wildlife Refuge in deep floodplain soils. Carolina Wrens also used revegetated woodlands with taller than normal tepehuaje or Mexican ash (*Fraxinus berlandieriana*). In general, Carolina Wrens were associated with high canopy cover but avoided areas with abundant mesquite foliage and higher foliage density at 1-2 m (usually mature thorn-scrub in drier areas). Carolina Wrens were generally less common at sites more severely affected by 2010 floods, where taller trees had died and dense low grass/herbaceous cover developed.

Table 1 - % of sampling regimes where wrens were observed

HABITAT (sampling regimes)	Carolina	Spot-breasted
Lower Rio Grande Valley, TX	% recorded	% recorded
Mature woodland (65)	30.1	NA
Revegetated woodland (31)	32.6	NA
Urban woodlots (7)	35.7	NA
Residential areas (7)	0	NA
Tamaulipas, MX		
Lowland riparian forest (10)	0	80
Canyons/lower montane forests (11)	72.7	100
Yucatan Peninsula, MX		
Semi-deciduous and semi-evergreen forest (39)	48.7	64.1
Semi-open disturbed roadside habitat (19)	31.6	57.9

NA = not applicable, species does not occur geographic region

Tamaulipas

Lowland riparian forest - We did not detect Carolina Wrens in 10 visits to our lowland study areas, the Rio Corona riparian forest 25 km northeast of Ciudad Victoria, and the lowland forest along the Rio Sabinas and Rio Frio near Gomez Farías. However, we recorded Spot-breasted

Wrens on 80% of our visits to lowland forest. On average, we detected a mean of 3.00±2.45 Spot-breasted Wrens in this habitat. Both species were absent from the Nacimiento of the Rio Frio near Gomez Farías.

Canyons and lower montane slopes - We recorded Carolina Wrens regularly in small numbers in this habitat. Most individuals appeared to be singing from densely forested slopes above river level. They occurred at 8 of 11 locations, averaging 1.36±1.21 individuals/survey. We detected 0-3 individuals north of Ciudad Victoria at El Tigre/Upper Rio Corona and Los Troncones, and 0-1 individuals on montane slopes near Gomez Farías. Spot-breasted Wrens were more abundant, averaging 5.27±5.59 individuals/survey: 1-3/survey at El Tigre/Upper Rio Corona and Los Troncones, and 7-18/survey on lower slopes in the Gomez Farias area. This species sang from river-level thickets or on the lowest slopes north of Ciudad Victoria, and more generally on montane slopes in the Gomez Farías area. In our one exploratory visit to higher, more open montane woodland west of Ciudad Victoria (May 2007), we recorded only one Carolina Wren and no Spot-breasted Wrens.

Yucatan Peninsula

Semi-deciduous forest and semi-evergreen forest - At our survey sites in the states of Yucatán, Campeche, and Quintana Roo, we detected Carolina Wrens on almost 50% of our surveys and Spot-breasted Wrens on almost 65% of our surveys in this habitat. We detected 1.05±1.41 Carolina Wrens and 1.28±1.32 Spot-breasted Wrens/survey point. Carolina Wrens were slightly less common in semi-evergreen forest of coastal Quintana Roo and southern Campeche. Farther north and west, in the semi-deciduous forest of southern Yucatán and northern Campeche, we detected up to 5 individuals/survey. JSB saw an adult Carolina Wren feeding a fledgling in open forest at the Sayil archaeological site on 18 May 2011, documenting successful breeding. Spot-breasted Wrens tended to be less regular in the more open forest sites such as Kabah and Uxmal in southern Yucatan, and at Chacchoben and Dzibanché in southern Quintana Roo.

Disturbed roadside and village edge habitat - Carolina Wrens were much less common here, occurring on < 33% of our surveys and averaging 0.53±0.84individuals/survey. Their presence was associated with patches of forest mixed with agricultural and other disturbed habitats, especially in semi-deciduous forest of southern Yucatán and northern Campeche. Spot-breasted Wrens occurred on over 55% of surveys, averaging 1.26±1.56 individuals/survey. Both species were very infrequent in low scrub at village edges or in wetlands.

DISCUSSION

In the LRGV, we observed Carolina Wrens using a variety of wooded habitats, including mature woodland, regenerating woodland, and small patches of woodland in urban areas (urban woodlots). Their association with taller, more mesic riparian forest with a fairly open understory was reflected in their use of revegetated areas with similar characteristics. Unlike many areas of the southeastern USA, Carolina Wrens did not use well-vegetated suburban "backyard" habitat (Brush and Feria 2015). Brush's (2016) more thorough data set of 55 census points during May-June 2015 and 2016 also failed to record them in residential habitat. Within the urban woodlots

in the McAllen-Edinburg area, Brush (2016) detected Carolina Wrens only in the urban woodlots with tallest, densest canopy cover.

Further south, we documented limited habitat use by Carolina Wrens in a variety of wooded habitats in the areas of Tamaulipas and the Yucatan Peninsula which we visited. Carolina Wrens occurred in semi-deciduous as well as moister semi-evergreen forest in the Yucatan Peninsula, as well as in canyons and slopes covered by dense lower montane woodland in Tamaulipas. We did not find them very frequently in disturbed roadside habitat (Yucatan Peninsula) and not at all in lowland riparian forest (Tamaulipas). Overall, there was quite a bit of overlap in occurrence between Carolina Wrens and Spot-breasted Wrens. Spot-breasted Wrens primarily used the same forest and woodland as Carolina Wrens, but they also occurred in more disturbed, dense habitats along roadsides and field edges. Carolina Wrens may occur in more open montane scrub (Tamaulipas) than do Spot-breasted Wrens, but further investigation is needed.

It is puzzling that only Spot-breasted Wrens used the tall, moist, lowland riparian forests that we surveyed in Tamaulipas. These forests appeared to contain suitable habitat for Carolina Wrens, based on their use of similar habitat in the Lower Rio Grande Valley of Texas (Gehlbach 1987, Brush 2005). Likewise, Gehlbach (et al. 1976, 1987) failed to record Carolina Wren here in the 1970s. Although we have no evidence, we speculate that Spot-breasted Wrens may outcompete Carolina Wrens for space or other resources along the lowland Rio Corona through competitive exclusion (Brooks 1997). Coexistence in canyon habitats 40 km away from the lowland Rio Corona site needs further study to determine whether they use the same habitat/space, or if Carolina Wrens use mainly upslope scrub, as our limited data suggest.

Breeding has been difficult to document for Carolina Wrens, even in the LRGV, where there are more observers. The 1987-1992 Texas Breeding Bird Atlas Project confirmed breeding in only 3 survey blocks in the eastern LRGV, even though we know the species occurs more widely in the area (Brush 2005, Tweit 2007, Brush and Feria 2015). The brief nature of our field trips to Tamaulipas and the Yucatan Peninsula precluded searching for nests, but Carolina Wrens likely breed regularly in both areas. Our observation at Sayil (Yucatán) of an adult feeding a begging juvenile is one of the few such records for the southern part of its range. No nests or eggs have yet been recorded for Carolina Wren in the Yucatan Peninsula (Howell and Webb 1995, Brewer 2001). Likewise, given that Spot-breasted Wrens may inhabit even denser habitat than Carolina Wren, it is not surprising that we saw no nesting activity of this species. In general, Spot-breasted Wren is better known from museum records and vocalizations than field sight records (Arnold 1966, Howell and Webb 1995). Binford (1989) reports one of the few records of nest construction for this species.

Although we did not undertake any taxonomic investigations, these observations explore the habitat use and ecology of several poorly-known Carolina Wren subspecies: *T. l. lomitensis* in the LRGV, *T. l. berlandieri* and possibly *T. l. tropicalis* in Tamaulipas, and *T. l. albinucha* (sometimes separated into Cabot's Wren or White-browed Wren, *T. albinucha*) in the Yucatan Peninsula. Additional data are needed on breeding requirements of birds in all areas, and more specific habitat use data are also needed for Mexican birds.

ACKNOWLEDGMENTS

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Ornithogeography of the Tamaulipan Biotic Province and collecting expeditions in México

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Abstract – The TBP is a transitional area from the Holarctic to the Neotropics. The high avifaunal diversity represents an intermingling of elements from the north, west and south, with a minimum of endemic species. The low rate of species endemism in conjunction with the moderate number of endemic subspecies reflects a late Pleistocene refugium within the region. Extension of the river systems (especially in the southern half of the province) in a northward direction towards the foothills of the Sierra Madre Oriental has greatly influenced the northern limits of many Neotropical species. The avifaunal element of the regional fauna strongly suggests that the southern boundary of the TBP is at the Río Tamesi and along the major tributary the Río Guayalejo in the southwest, with the 650 m contour line as the western boundary. Humans have drastically altered the vegetation of this area, especially the riparian woodlands, and have consequently greatly affected the patterns of avian distribution in the province. The manuscript also includes remembrances from students of Keith Arnold who accompanied him on field trips to the TBP and beyond in Mexico. Since such experiences are rare today, they provide a historical account for field biologists today.

ORNITHOGEOGRAPHY OF THE TAMAULIPAN BIOTIC PROVINCE

From an ornithological perspective the region which we call the Tamaulipan Biotic Province (hereafter, TBP) holds our interest from 3 points of view: 1) the area serves as a major migration corridor for circum-gulf migrants, 2) the coastal portion of this area serves as a major wintering area for waterfowl and other aquatic birds from the Central and Mississippi Flyways (Saunders and Saunders 1981), and 3) in this area the Neotropical and the Nearctic avifauna merge.

Generally the avifauna of México is well known; the proximity to the United States of the TBP has invited large numbers of amateur and professional ornithologists to explore the area. For budding biologists in the southwestern United States, México had long been a place where one could quickly and inexpensively drive to experience a wide array of temperate and tropical habitats from sea level to >3000 m. México ranks third in biological diversity in the world (Mittermeier 1988), despite the fact that it is only the fourteenth largest country in the world, having a land area ~25% that of the United States. Its ease of access and safe and friendly environs during the mid-20th century made it the perfect training grounds for many universities. W.B. Davis, founder of the Wildlife and Fisheries Sciences Department at Texas A&M University, had built the Texas Cooperative Wildlife Collection (TCWC, today the Biodiversity

Research and Teaching Collection [BRTC], but still cited as TCWC) largely by taking his students on collecting field trips to México in the 1940s and 50s. As an emeritus professor and former department head, he encouraged new young professors at A&M to take their students to México as often as possible to provide them field experience and hands-on collecting at its best. Keith Arnold (KAA), as curator of birds at the TCWC, was eager to build the collection, and having had experience in Costa Rica as a graduate student was well equipped to take his students to México.

By the early 1970s México had begun to enforce wildlife laws more stringently. Their laws were respected and enforced by U.S. Customs, making it necessary to navigate a great deal of red tape to acquire permits to collect and import birds. Bats, rodents and cold-blooded taxa were largely still ignored by authorities. The requirement for permits for birds, and eventually all taxa, made it imperative to plan bird collecting trips far in advance and in much greater detail than had previously been the case. It was in this environment that the trips reported here were undertaken.

Making general collections of museum specimens in 2017 is a less accepted form of study during regular courses in field biology, although acquisition of certain specimens is very important in targeted systematic research or surveys of critically important regions. Society frowns with increased frequency on the idea that free, diminishing populations of wild animals should be sacrificed for museum cabinets from which they perceive limited benefit (Collar 2000, Winker et al. 2010). Despite this, there is a real need to maintain museum collections in order to advance scientific knowledge (Collar 2000, Winker 2005). Lawler (2016) has stated that the lack of field skills among today's biology graduates is essentially ecological illiteracy. This is brought on in large part by students' current low exposure to collecting and identifying specimens they take in the field. This illiteracy makes it less likely for these students to recognize invasive species or observe changes in habitat due to development, fire, climate change or other causes.

Since the tragedy of 9-11 in 2001, travel is more complicated and restricted. México is no longer the safe and friendly place for preoccupied college students to roam the countryside looking for birds, rodents, bats, reptiles and amphibians. Consequently, while collecting trips of all types have diminished, those to México are now rare, and few students will ever get to participate in such expeditions. While there have been some efforts to document the overall nature (not only species lists but experiences) of such collecting trips (e.g., Winker 2010), they remain scarce.

Despite much study in the region, few publications actually address the avifauna of this area, and the majority of those that do consider mountain outliers or the foothills of the adjacent Sierra Madre Oriental. For this analysis we relied upon only the land birds recorded from the TBP for consideration. We considered in the analysis only those species that have been recorded breeding within the limits of the TBP or whose general distribution suggests their presence as a breeder in the area.

Herein we describe the ornithogeography of the TBP and provide examples based on expedition journal notes. In addition to the scribed notes and species inventories, we also include some memories that capture the feeling of a collecting expedition through the eyes of the students who participated on some of these last expeditions during the 1970s.

In the nearly 50 years that have passed since most of the authors have traveled in the Mexican portion of the TBP, much has changed. Many tropical species have moved north. There have been substantial changes in the habitat, most due to changes in land use, but also reflecting the trend of tropical species moving north. Visitation by biologists and birdwatchers has dramatically dropped within the study area due to political and social concerns within the last twenty years. But there has also been an explosion of observational data for most of Latin America, which is accessible through eBird. Because of these changes, we feel it worthwhile to report on two expeditions for which the authors had sufficient notes. Both trips were in the 1970s to which we added remembrances in 2017. Those and other forays into México, along with literature and museum specimens, formed the knowledge base from which we prepared the TBP ornithogeography analyses. We have supplemented this information with more recent literature and eBird data to compile the list of breeding species analyzed for this paper.

Methods

The vegetation over much of the area consists of an arid grassland and thorn scrub, dissected by a series of rivers arising in the Sierra Madre Oriental; these rivers have supported fairly extensive mesic riparian woodlands. As highly mobile vertebrates, birds are less restricted by rivers as physical barriers than are many other vertebrates. Two distinct groups emerge among the land birds of this region: one that ranges throughout the arid portions of the region, and the other that is confined to the mesic riparian woodlands. The latter group also extends its range northward along the foothills of the Sierra Madre Oriental where the vegetation becomes more mesic (Eaton and Edwards 1948). A third element consists of species that occupy the outlying Sierra de Tamaulipas and the Sierra San Carlos, as well as the encroaching foothills of the Sierra Madre Oriental. Pine-oak and oak woodlands provide additional habitat for some species (Phillips 1911, Sutton and Burleigh 1939, Sutton and Pettingill 1942, 1943, Eaton and Edwards 1948, Martin et al. 1954).

Specific areas within the TBP or locales for species are based on a number of publications read over the years, personal knowledge of the region, and examination of specimens in the BRTC. Scientific and common names, especially of birds follow Clements (2016). Coordinates were gathered with the use of Google Earth and from the gazetteer in Dixon and Lemos Espinal (2010). Elevations were taken directly in the field with the use of a hand held altimeter or from Google Earth.

Results and Discussion

Northern limits of the Neotropics

Because of the strong Neotropical element in the avifauna of the TBP, the northern limit of this element has held the interest of ornithologists for some time (Gehlbach et al. 1976). However, as the Neotropical birds in the TBP really separate into two distinct groups according to habitat requirements, establishment of a “northern limit” is more difficult than Gehlbach et al. (1976) imply.

Appendix 1 presents northern limits of Neotropical genera by river systems within the TBP. Both the Río Tamesi and the Río Soto la Marina drainages have major tributaries that extend

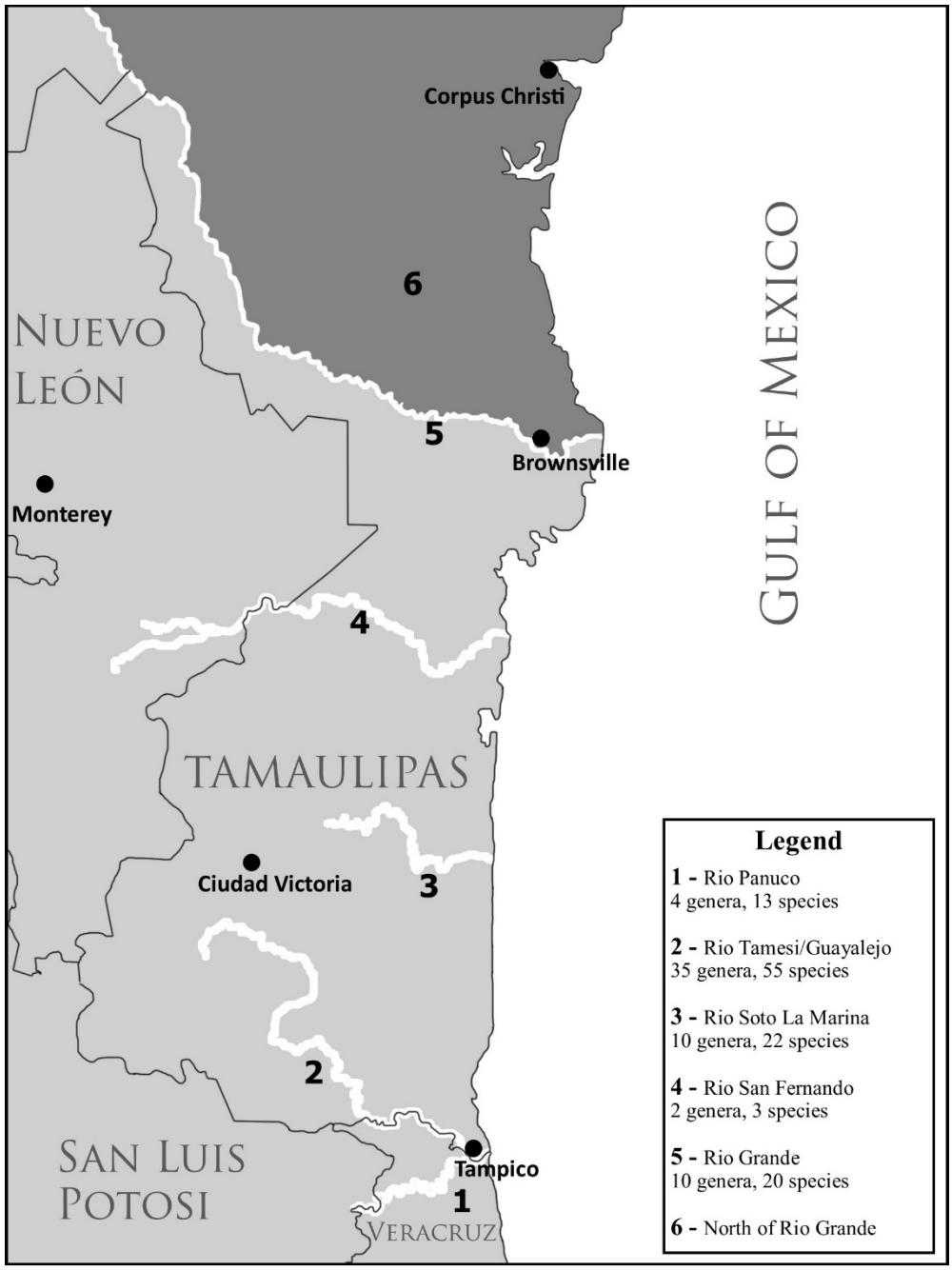

Figure 1 - Genera and Species lost by river.

northward into the foothills of the Sierra Madre Oriental for some distance from the general west-east flow of the main river. Figure 1 illustrates the exclusion of tropical forms by river; from south to north we see the following exclusions from riverine barriers of tropical forms: Río Panuco – 4 genera, 13 species; Ríos Tamesi/Guayalejo – 35 genera, 55 species; Río Solo la Marina – 10 genera, 22 species; Río San Fernando – 2 genera, 3 species; Río Grande – 10 genera, 21 species; north of the Río Grande – 5 genera, 10 species. The low figures for the Río Panuco may very well represent poor knowledge of the avifauna for that region. The high numbers for the Río Tamesi and its major tributary the Río Guayalejo probably represents a more appropriate 'boundary' of the Neotropics on the Gulf lowlands of México. The low figures

for the Río San Fernando accurately portray the reduced riparian vegetation in this drainage and the lack of a major tributary reaching the Sierra foothills. The figures for the Río Soto la Marina, the Río Grande, and the numbers extending beyond the Río Grande reflect the transitional nature of the entire TBP. The majority of the species dropping out at the river systems are closely tied to the riparian habitat, while the species extending beyond the Río Grande are those which thrive in xeric brush and grasslands.

Faunal elements of the TBP

Appendix 2 lists the 253 species which are known to breed within the TBP, or which we believe probably breed based on their overall distributions. We have identified the following faunal elements within the list of species and have represented the percentages of non-passerine (NP) vs. passerine (P) within each element.

1) Southern Peripheral (SP) – 66 species ranging over much of South and Middle America, with their northeastern limits occurring in the TBP. NP = 62%, P = 38%
2) Middle American (MA) – 57 species ranging from México through most of Central America and Panama; such species may extend into the southwestern United States or northern South America. NP = 37%, P = 63%
3) Northern Peripheral (NP) – 38 North American species which range into México and perhaps into northern Central America; they usually have their southeastern limits in the TBP. NP = 24%, P = 76%
4) Western Peripheral (WP) – 34 species with distributions mainly in western (or southwestern) North America and México, perhaps into northern Central America; many of these species are widespread over the Mexican plateau. NP = 24%, P = 77%
5) Mexican (M) – 30 species whose distribution is primarily within México, but which may extend into the southwestern United States or northern Central America. NP = 33%, P = 67%
6) Pan American (PA) – 19 species ranging widely throughout much of North, Middle and South America. NP = 58%, P = 42%
7) Core (C) – 6 species which appear to have their origin in the TBP, but now extend outside the area in the adjacent parts of México, the United States, and northern Central America; these species generally are restricted in México to the Atlantic versant. NP = 33%, P = 67%
8) Endemic (E) – 3 species occurring only within the limits of the TBP. NP = 67%, P = 33%

Of the 253 species we listed, 104 (41%) are non-passerines and 149 (59%) are passerines. The proportions of non-passerines vs. passerines differ between the various faunal elements. The small numbers of species in the endemic and core groups are not instructive as to the proportions of non-passerines and passerines.

However, the excessive numbers of passerines among the northern peripherals, the western peripherals, and the Mexican categories supports the suggestion of a northwestern Mexican refugium during the Pleistocene (Mengel 1964). Similarly, the high proportion of passerines among the Middle American birds may reflect the ‘islands’ in Middle America during the Pliocene and Pleistocene, given the relatively short speciation time proposed by Moreau (1930). The high proportion of non-passerines in the southern peripheral groups reflects South America’s origin and isolation until the late Pliocene. Together the northern and western peripherals demonstrate the ‘spilling over’ effect of forms from the Chihuahuan Biotic Province from the

Mexican plateau. At the same time, the collective numbers of Middle American and southern peripheral species reflect the presence of the outlying Sierra San Carlos and the Sierra de Tamaulipas in conjunction with the penetration of the river systems into the foothills of the Sierra Madre Oriental. Many of the species in these two elements breed only along riparian corridors or in the foothills and mountains above 650 m.

Endemism in the TBP

Although endemism at the species level is low (3 species; App. 2), we identified 26 species that have evolved ≥1 endemic subspecies (App. 3). These endemic forms come from all elements (in descending order): NP – 8, MA – 7, M – 3, WP – 2, and PA – 1. These subspecies include six non-passerine orders, plus passerines representing nine families. Interestingly, one species, Carolina Wren (*Thryothorus ludovicianus*), has evolved three subspecies within the TBP (Clements 2016). *T. ludovicianus* may reflect the importance of the major river systems within the TBP as refugia, while the habitat of the TBP is a hostile environment for the species. The presence of this many of endemic subspecies, together with three endemic species and six core species, supports the existence of a northeastern México refugium during the late stages of the Pleistocene (Mengel 1964).

Boundaries of the TBP

For the concept of a biogeographical region to be valid, the region must have some coherence within the various biotic elements. The true southern boundary should be the Ríos Tamesi-Guayaljo river system, where a significant reduction occurs in the Neotropical element (Fig. 1). In the west the congruent boundary would come near the 650 m contour line, eliminating most of the species that breed within the pine-oak or oak belts. The northern boundary at the southern edge of the Balcones Escarpment in Texas seems realistic when viewed from the aspect of the continuance of the thorn scrub. A few species have recently extended beyond this region onto the Edwards Plateau and northeast along the coastal prairies in Texas.

Introductions and human influences

The native avifauna of the TBP has experienced dramatic changes since the beginning of the 20th century. Four Old World species have established themselves: Rock Dove (*Columba livia*), Eurasian Collared-dove (*Streptopelia decaocto*), European Starling (*Sturnus vulgaris*) and House Sparrow (*Passer domesticus*). These four species have become established in every part of the world where European humans have settled.

Humans, however, have had far more devastating effects on the TBP avifauna. The clearing of large areas for agricultural use, along with increasing human population growth has greatly altered vegetation patterns, especially among the riparian woodlands. The recent influx of Neotropical birds into the Lower Río Grande Valley of Texas may reflect the dramatic reduction in habitat for these species in the TBP. The increasing pressures for lumber and firewood have resulted in severe impacts on the woodlands of the foothills where many of the Neotropical species reside. The future outlook for the Neotropical element in the TBP is not encouraging.

Biographical significance

The major feature of the TBP is the transitional nature of the avifauna from the Neotropics to the Holarctic. This area has served as a 'corridor' for the northward movement of Neotropical birds

into Holarctic regions, for southern movements of birds from forested regions of eastern North America, and for the more arid forms from the southwestern portions of the United States and northwestern México (i.e., Chihuahuan desert fauna). Currently this same area probably serves as a barrier for those Neotropical species that require mesic woodlands. The probable Pleistocene refugium of this area, possibly in the foothills of the Sierra Madre Oriental, influenced the avifauna of adjacent northern and western regions. The Golden-cheeked Warbler (*Setophaga chrysoparia*) undoubtedly had its origin in this refugium (Mengel 1964).

Conclusions regarding TBP Ornithogeography

1) The TBP is a transitional area from the Holarctic to the Neotropics. The high avifaunal diversity represents an intermingling of elements from the north, west and south, with a low number of endemic species.
2) The low number of endemic species in conjunction with the moderate number of endemic subspecies reflects a late Pleistocene refugium within the region.
3) Extension of the river systems (especially in the southern half of the province) in a northward direction into the foothills of the Sierra Madre Oriental has greatly influenced the northern limits of many Neotropical species.
4) The avifaunal element of the regional fauna strongly suggests that the southern boundary of the TBP is the Río Tamesi and along the major tributary the Río Guayalejo in the southwest, with the 650 m contour line as the western boundary.
5) Humans have drastically altered the vegetation of this area, especially the riparian woodlands, and have consequently greatly affected the patterns of avian distribution in the province.

MEXICAN ORNITHOLOGY EXPEDITIONS

November 1972 Expedition

Three Mexican sites (Fig. 2) were visited during this expedition, each distinct from one-another in significant ways. The Río Corona site (Tamaulipas, 23°56’14”N, 98°56’12”W, 160 m asl) is located 31.5 km northeast of Ciudad Victoria on Hwy 101. At the time of this work (45 yr ago) the Río Corona site was a riparian forest on the Gulf Coast plain. The stream was dominated by Montezuma cypress (*Taxodium mucronatum*), anaqua (*Ehretia anacua*), and Texas ebony (*Ebenopsis ebano*). The narrow riparian forest was flanked by Tamaulipan thorn scrub. Much of the surrounding thorn forest has now been cleared for agriculture, and the overall habitat diminished. The river was 20-50 m wide and much of it was <1 m deep, although there were many deeper cuts and eddies. The gallery forest only extended $\leq$10 m beyond the upper stream banks. The simple nature of the forest limited the species and population of birds that utilized this habitat. The clear stream with permanent flow provided habitat for many aquatic species such as herons, sandpipers and kingfishers.

El Salto Falls (San Luis Potosí, 22°35’10”N, 99°23’01”W, 460 m asl) is below the Tropic of Cancer in the foothills above the coastal plain and contains a major 70 m waterfall at the campsite on Río El Salto. The falls were managed to provide water for the region, with a shunt pipe system that provided a constant stream of water, even during low water periods. At the time of this expedition the water provided habitat for ducks, grebes, egrets, herons, finfoot and kingfishers. The falls and associated cliff provided habitat for White-collared Swift and Bat

Falcon. The river below the falls had Montezuma cypress (*Taxodium mucronatum*), lead tree (*Leucaena leucocephala*)**,** gumbo-limbo (*Bursera simaruba*), *Cecropia*, and other tropical forest species. The area above the falls was similar habitat but with a higher diversity of trees. The area below the falls transitioned into of Tamaulipan scrub tropical thorn forest.

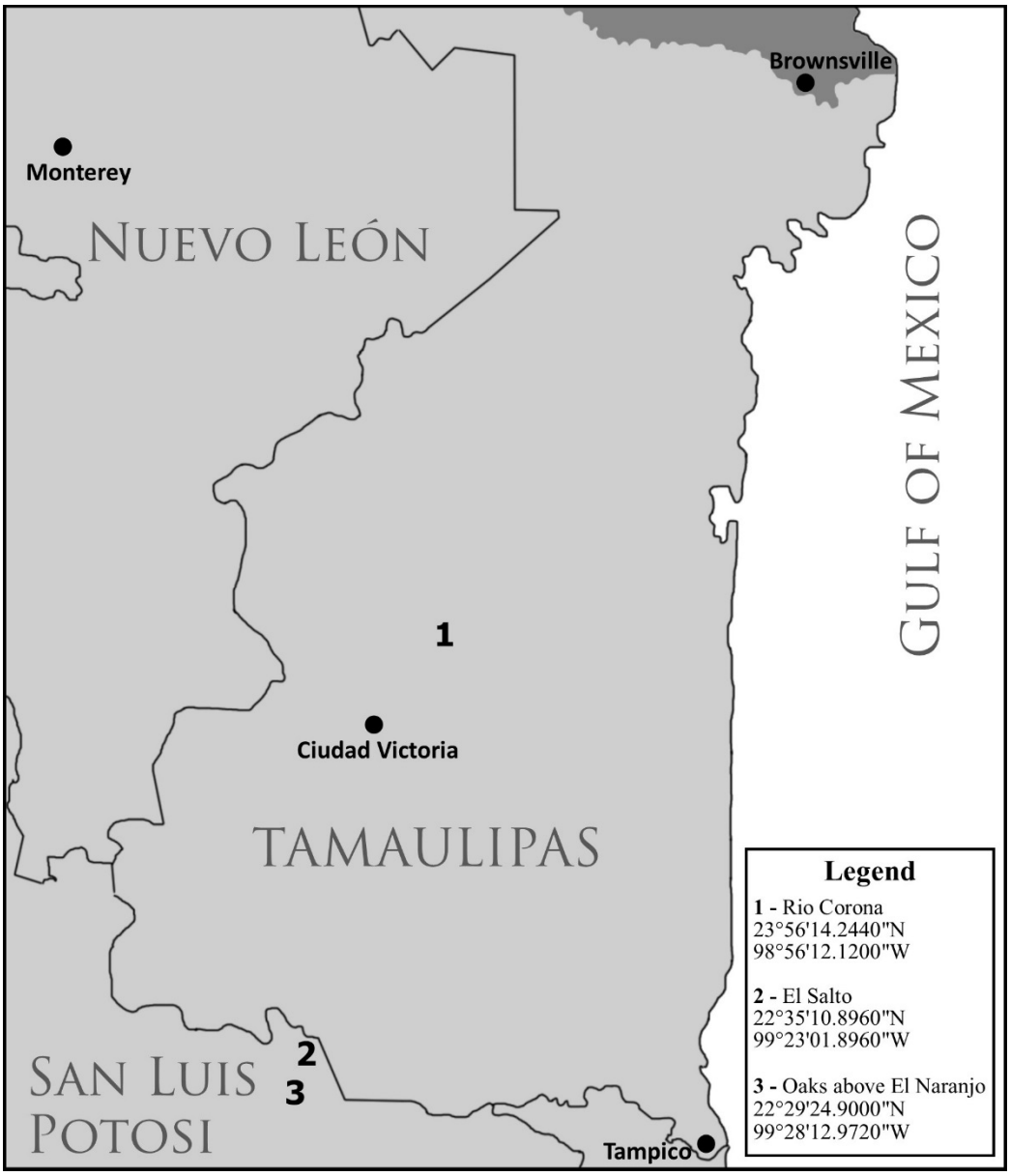

Figure 2 – The three sites visited during the 1972 expedition.

"The Oaks" above El Naranjo was the field name used for a site beside the highway with oak trees (San Luis Potosí, 22°29'24"N, 99°28'12"W, 1150 m asl) in the Sierra Madre Oriental, is significantly higher than the other sites, and is also south of the Tropic of Cancer. The tropical forest transitioned from lowlands dominated by sabal palm (*Sabal mexicana*) to hillsides where ponytail palm (*Beaucarnea recurvata*) was prevalent; the wetter slopes were dominated by oaks. Some deeper mountain cuts had small streams, and those areas had more tropical forest plants. The oaks at higher altitudes were covered with epiphytes, dominated by bromeliads. The

understory had a small palm (*Chamaedorea microspadix*) whose fronds formed the basis of a floral harvest industry. The highest and wettest areas had stands of sweetgum (*Liquidambar styraciflua*), a cloud forest indicator species. Towards the west into the mountains, the western side is more xeric and the oaks are without significant epiphytes. In this region the forest understory disappears and is replaced by grass.

This was the first trip Arnold led to México with his students. The field team was comprised of KAA (Leader), GFC (who had visited these three sites repeatedly since 1969), Joseph Folse, Fred Hendricks (who had extensive experience collecting herps in México), Steve Holmes, Ron Klein, Wayne Marion, George Newman, and Paula and Roberta Summers. For most of the students this was their first experience in México and the tropics.

The itinerary was as follows: 1 November - Left College Station at 06:30 hrs and arrived Río Corona at 19:30 hrs. Fieldwork commenced along the Río Corona until 09:00 hrs and we left at 10:00 hrs on 2 November. Drove to El Salto, arriving for lunch ~13:00 hrs, leaving at 11:00 hrs on 3 November. Arrived at The Oaks above El Naranjo ~12:00 hrs, leaving at 11:00 hrs on 4 November. Drove to Bentsen-Río Grande State Park (Hidalgo Co., Tx) arrived ~23:00 hrs after considerable separation of our two-car caravan. Fieldwork commenced at Bentsen until 07:00 hrs on 5 November, whereupon we drove east to Santa Ana National Wildlife Refuge (Hidalgo Co., Tx), arriving ~08:30 hrs after a brief breakfast stop. Fieldwork commenced at Santa Ana until 11:00 hrs before driving back to College Station at arrive ~18:30 hrs.

Results and Discussion - 1972 Expedition

We observed a total of 113 species (App. 4). Varying numbers were observed at each site: 35 at Río Corona, 61 at El Salto, and 66 at El Naranjo (App. 4). Only 11 species (9.7%) were common to all three sites. Five of the 11 were Neotropical migrants that were winter residents or transients. Thirty-nine species (34.5%) did not regularly occur in Texas and the United States. There were 22 (19.4%) shared species between Río Corona and El Salto, 14 (12.3%) shared between Río Corona and The Oaks above El Naranjo, and 27 (23.8%) shared between El Salto and The Oaks above Naranjo.

The Río Corona site is in the temperate zone, while both El Salto and The Oaks above El Naranjo are within the tropics. The diversity observed illustrates increased diversity towards the tropics. Even without a significant water body in the mountains above El Naranjo, the vegetation variety of these tropical forests hold the highest diversity of the three sites. The Oaks above El Naranjo has a more varied and diverse forest structure, along with a diversity of elevation and exposure, creating more microhabitats than at El Salto. El Salto has a major waterfall and a large river with an associated variety of river edge and wetland habitats. The students were able to observe many bird families that are primarily or exclusively tropical such as motmots, parrots, woodcreepers and cotingas. The trip clearly demonstrated for the students the basic principles of tropical diversity.

Epilogue - 1972 Expedition

These three sites have been severely impacted by land use that have cleared much of the habitat and adjacent areas, rendering each fragmented and isolated. It is unlikely they yield productivity for avian populations, and in the case of the Río Corona site, it is likely now a population sink.

While it once was a stepping stone for populations to expand north to the Río Grande Valley of Texas, this is no longer today.

Likewise, the area where this trip was made is now subject to robbery, kidnapping and hijackings by violent gangs or desperate residents. It is a shame that the wonderful country of México, with its warm and friendly people, is not presently a place for young biologists or care-free birdwatchers to explore.

28 December 1973 – 10 January 1974 Expedition

The Río Corona and El Salto sites (Fig. 2, 3) were described above for the 1972 expedition. During the 1973 expedition the river and falls at El Salto were not flowing, but there were very clear, cool pools at the base of the falls. Mixed deciduous woods were abundant in the area, but were dry at the time. Nonetheless Bat Falcons were active and roosting in a tree above the falls,

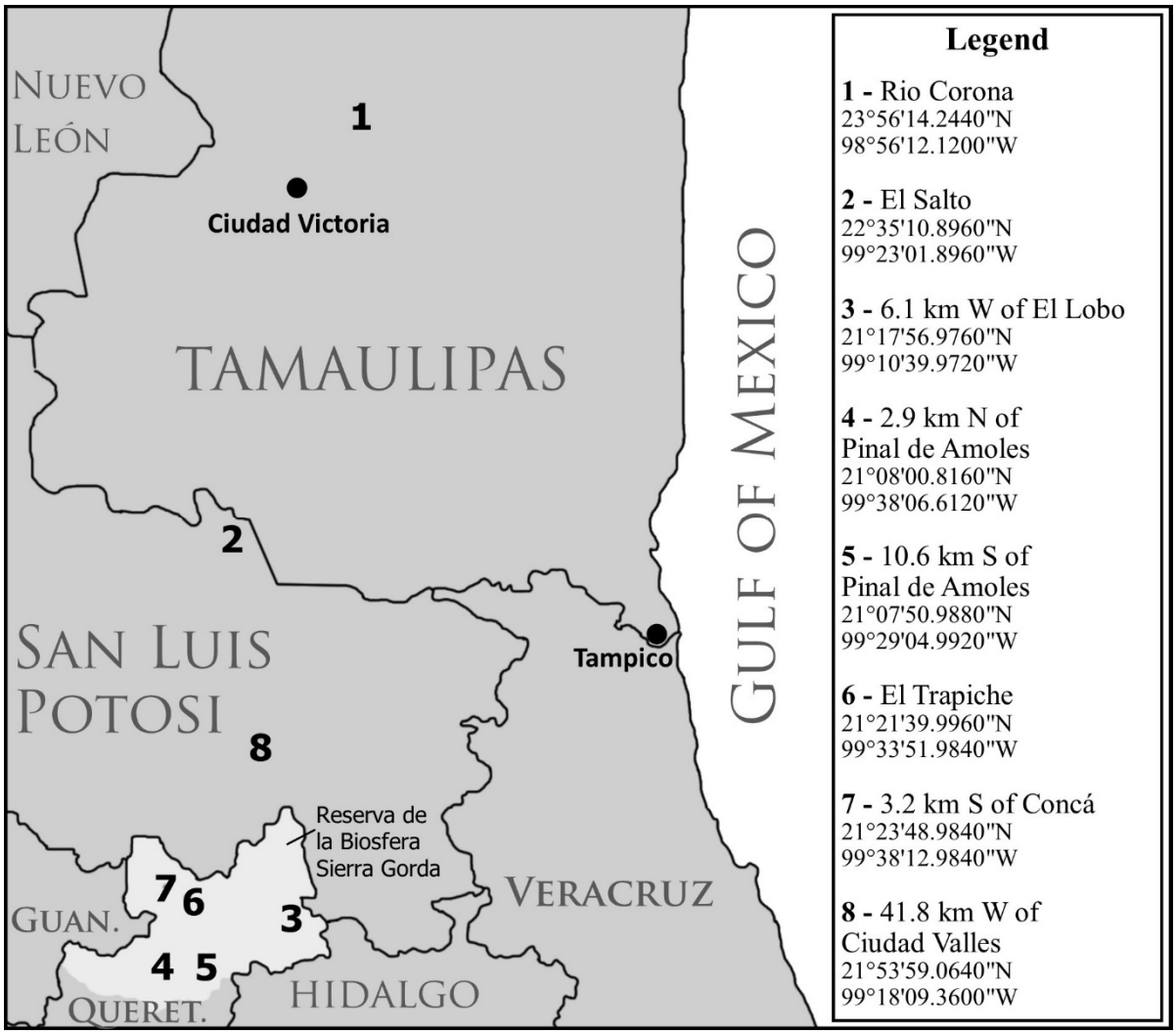

Figure 3 – The eight sites visited during the December 1973-January 1974 expedition.

and Military Macaws visited the 70 m high face of the falls for roosting. Other sites, all in Querétaro unless noted below (Fig. 3), are described briefly, as follows:

El Lobo (21°17'56"N, 99°10'39"W, 1585 m asl) camp was located 100 m down a dirt road on the right, 6.1 km west of El Lobo, in Pine-Oak forest with many rotted logs (due to past logging) and many granitic outcrops and stones.

Pinal de Amoles Camp 1 (21°08'00"N, 99°38'06"W, 2590 m asl) was 2.9 km north of Pinal de Amoles on Hwy 120, with Pine-Oak forest similar to El Lobo. Camp 2 (21°07'50"N, 99°29'04"W, 1890 m asl) was 10.6 km south and contained two mines in the nearby ravine, sparse Sweetgum-Oak associations with steep, rocky hills surrounding camp.

El Trapiche (21°21'30"N, 99°33'51"W, 700 m asl) camp was at the northern city limits along the clear, 10-15 m Río Jalpan, with riffles and lined with Cypress. Xeric hillsides were covered with rocks and Acacia, and nearby there were cornfields interspersed with dry ravine beds.

Ex-Hacienda Concá (21°25'46"N, 99°36'45"W, 610 m asl) was 3.2 km south of Concá, and 16 km north of El Trapiche, near the Río Santa María. Lush vegetation in camp, but xeric beyond. Warm springs, associated creek and dark loam soils provided moist habitat to sample. Nearby hills xeric and rocky with abundant bombax (*Pseudobombax ellipticum*) and mala mujer (*Cnidoscolus* sp.).

41.8 km west of Ciudad Valles (San Luis Potosí) on Hwy 70. Dense woods and brush (bullhorn acacia).

Figure 4 – (L-R): Jay Dixon (1), Stan Hayes (2), KAA (3), Joe Weber (4), Mary Dixon (5), Jeff Neuber (6), Tanya Dixon (7), Richard Jones (8), Noel Adams (9), Jim Dixon (10), Dawn Dixon (11), Barbara Nagle (12), Pat Johnson (13), Scott Smith (14), JCN (15), Dave Moore (16), Fred Wills (17), Al Barr (18), Toby Dixon (19), Bob Adamcik (20) and Will Way (21). (Photo by R.A. Thomas, expedition member also).

The participants (Fig. 4) were led by Keith A. Arnold and James R. Dixon and his family. The itinerary (and associated notes) follows:

December 28 – Left College Station at 05:50 hrs, arriving at Río Corona at 21:10 hrs.

December 29 – Field work 06:30-11:00 hrs. Dixon and crew seined the river and collected threadfin shad (*Dorosoma petenense*), banded astyanyx (*Astyanyx fasciatus*), Texas or Río Grande cichlid (*Cichlasoma cyanogutattus*) and molly species. Left Río Corona and crossed the Tropic of Cancer at 12:05 hrs, arriving El Salto Falls at 15:15 hrs. Our field crew climbed the steep edge and actually sat in the dry riverbed and watched birds moving over the canopy. Mist nets were set and monitored from 16:30-21:00 hrs.

December 30 – Same locality. Mist nets set and monitored from 06:30-13:30 hrs. Eight fruit bats (*Artibeus* sp.) were mist netted (4 released) and a deer mouse (*Peromyscus* sp.) caught in a Sherman trap. Thomas, Al Barr and Newnam birdwatched west along the south side of the river, up the cliffs the hard way, across the falls and back to camp by 11:00 hrs.

December 31 – Departed El Salto Falls at 08:15 hrs and arrived in Ciudad Valles at 10:15 hrs, arriving in El Lobo at 14:30 hrs. We placed one set of three mist nets ca. 300 m further along the dirt road and 50 m up the mountain, then birdwatched until 17:40 hrs. At 20:00 hrs a male Vermiculated Screech-Owl was found in a mist net 2.2 km west of El Madroña at 1676 m. Some members of the team visited "Guyer's sink", one of Frank Guyer's study areas when he did his Master's thesis at Texas A&M University on the ecology of the salamander (*Chiropterotriton*) in the sinks and caves of eastern México. Al Barr, Newnam and Barbara Nagle went to a cloud forest on the other side of the mountain, accessible by truck if dry.

January 1 – Same locality. Mist nets run from 07:00-20:00 hrs. Dr. Arnold and four students birdwatched up the mountain to approximately 2133 m. Weather was overcast and misty. On this trek, one Hermit Thrush, three Elegant Euphonia (2 males and 1 female), and one Gray-breasted Wood Wren were collected with a shotgun. Al Barr, Will Way, Barbara Nagle and Newnam left camp to follow the dirt road about 3 km to a pass and down 1 km into a rainforest dripping water with very low clouds.

January 2 – Left El Lobo site at 08:48 hrs for Pinal de Amoles. We arrived at our camp site, a well-littered parking area, at 11:25 hrs. After lunch we set three mist nets in a swale up the mountain from camp and then birdwatched the hillside. We did a final check of the nets at 22:00 hrs. Drought-induced drooping-needle pine (Mexican piñon pine, *Pinus cemroides*) forest, floor mostly covered with pine needles, few logs, lots of rocks on sunny slopes, many rocky road cuts to examine.

January 3 – We birdwatched along the road. Departed camp at 11:20 hrs for Pinal de Amoles and ate lunch. Arrived at our camp site at 13:45 hrs located in a gravel pit 10.6 km east of Pinal de Amoles. Three mist nets were set along a dry creek bed. After dinner a female Mexican Whip-poor-will (*Antrostomus arizonae*) was collected by shotgun.

January 4 – Mist nets checked at 07:00 hrs - no birds or bats present. Broke camp at mid-day, stopped for supplies and food in Jalpan de Serra then on to camp on the Río Jalpan at El Trapiche.

January 5 – Same locality. We were awoken at 06:30 hrs by a burro braying. Checked the net over the river and found four dead Spotted Sandpipers (*Actitis macularia*); they were collected and prepared. A female Blue-capped Motmot (*Momotus coeruliceps*) and a female Boat-billed Flycatcher (*Megarynchus pitangua*) were collected from the nets next to the river.

January 6 – Checked mist nets at 07:30 hrs - nothing captured. Broke camp and arrived 09:40 hrs at Ex-Hacienda Concá. Camp was around the old, crumbling sugar mill (Fig. 7), and refreshing springs and creeks were used for bathing and drinking. Stayed at this site January 7-8.

January 9 – Left camp at 06:00 hrs, stopped in Río Verde (San Luis Potosí, 21°53'59"N, 99°18'09"W), for breakfast and shopping. Camped 41.8 km west of Ciudad Valles (San Luis Potosí) on Hwy 70.

January 10 – Left camp at 06:00 hrs with stops in Ciudad Valles for food, then on to arrive at 16:00 hrs at Río Corona camp site (Tamaulipas).

January 11 – Returned to College Station.

Results and Discussion – 1973-74 Expedition

We observed or collected 121 species during the entire trip (App. 5). Each site was rather distinct and we had varying numbers of species: Río Corona 35 species, El Salto 29, El Lobo 31, Pinal de Amoles 26, El Trapiche 38, Ex-Hacienda Concá 36. Sites on later days of the expedition were not visited for significant hours to include for analyses.

The sites varied a great deal in elevation from the lowland plains of Tamaulipas at the Río Corona to the mountains of Querétaro over 2500 m asl. Thus not too surprising that there were no birds common to all six sites where we spent at least parts of two days in the field. Clay-colored Thrush (*Turdus grayi*) was found at five of the six sites, and the group collected five specimens of this widespread species.

At two of the more montane sites, El Lobo and Pinal de Amoles, there was no significant water source, and the lack of aquatic birds such as Spotted Sandpiper (*Actitis macularia*), kingfishers and phoebes at these sites was drastically different. Riparian woodlands at or near camp sites were also an important contributor to bird diversity, by harboring tropical species not normally found in the pine-oak woodlands of the montane areas.

The group found a Golden-cheeked Warbler (*Setophaga chrysoparia*) at the El Lobo camp site area on 1 January 1974. At the time, the winter distribution of the species was poorly known so was a noteworthy contribution for the species' documented distribution. In 2017, it is a well-documented fact that the species is a regular transient and wintering species in Sierra Gordo Biosphere Reserve and its associated range.

Much of this expedition concentrated on five camping sites in which the group spent nine days in Querétaro. These sites are now within the Reserva de la Biosfera Sierra Gordo. This ~400,000 ha reserve is nearly the size of Rhode Island and renowned for its overall faunal and floral diversity, including high avian diversity. The reserve was established in 1997. In 2001 it was added to the International Networks of Man and Biosphere Reserves of UNESCO as the 13th Mexican reserve on the list. It harbors the highest ecological diversity of any reserve however. It is also recognized as an IBA (Important Bird Area) by Birdlife – Mexico. This expedition, as well as others led by Arnold and Dixon, helped provide the documentation to justify its designation as a biosphere of international importance.

Epilogue – 1973-74 Expedition

The Sierra Gordo Biosphere Reserve has become a great source of pride for México. It hosts frequent visitors from Mexican universities and the general public who visit to see, appreciate and study its great biodiversity.

SPECIAL MEMORIES OF THE STUDENTS

Albert Barr (73-74 expedition)
I took two trips into México with Dr. Arnold. One was with a fairly large group with Dr. Jim Dixon (TCWC Curator of Herpetology) and Dr. Arnold. We collected specimens on both trips. On the first trip with the large group, Arnold had Newnam and I setting mist-nets wherever we stopped. At Sharpton's Ranch (Ex-Hacienda Concá) we set up nets in some fig trees and caught fruit bats overnight. Someone brought in a vulture and some other birds, and Newnam and I spent the whole day making study skins. We decided that we would not be doing that the next day and got up very early and took off to the river for a swim. At another stop a child from a village brought in a hummingbird that he shot with a slingshot.

On the second trip there were only about six of us and Dr. Arnold. We took an A&M pickup truck and one of the vans. We went somewhere in México where there was no water. We only had water to drink for about three days. We (students) decided that when we left and found the first river, we were stopping and jumping in, and we did! We collected specimens on that trip as well. We set up mist nets and caught birds as well as bats. We made study skins of everything that we caught.

G. Fred Collins (72 expedition)
I saw my 'lifer' Collared Forest-Falcon (*Micrastur semitorquatus*) that swooped after another bird across the pool at the bottom of the El Salto Falls. I was observing birds while everyone else was enjoying a swim directly below the swooping falcon. I got a perfect and close look at the intense predator which the rest of the group did not see. Best swim I ever missed! Of course what no one missed was the large flock of 350 White-collared Swifts (*Streptoprocne zonaris*) that emerged from roosting behind the falls on our final morning of birding in México. These nearly falcon-sized swifts are spectacular in the air and put on a show for all of the observers. Although I had visited the The Oaks above El Naranjo several times in previous summers, this was my first fall visit. I was therefore surprised to see my 'lifer' Plumbeous Kite (*Ictinia plumbea*) soaring above the spot we pulled off the road to camp. It was a bird I had hoped to see in previous summer visits but not in November. Dr. Arnold just kept complaining, every time I found a good bird that he had no shotgun. Of course had he been armed and blasting away we probably would not have seen so many gems.

J. Cal Newnam (73-74 expedition)
This was my first trip to México and the tropics. All those who had never crossed the Tropic of Cancer performed the traditional Aggie ceremony at the crossing (Fig. 5). The ceremony included marching around the sign three times, face east, bow, and say "Ho Pien".

My first morning in México I was awakened by the chattering of Green Parakeets. Later I would be awakened by the braying of a burro. Such is México. El Salto Falls was memorable, partially because of our excellent views of Military Macaws (*Ara militaris*).

After one of our first birding adventures, we returned to camp at 1100 hrs for brunch. Three locals arrived and offered us a shot of Tequila for every time we jumped off a large rock into the river pools below the falls. After much coaxing I jumped, after that Thomas and I went together.

Figure 5 - On Aggie expeditions, all those making their first crossing of the Tropic of Cancer were required to make three circles around the highway sign, then bow to the east and say "Ho Pien" (Photo by R.A. Thomas).

Figure 6 - Newnam with freshly netted Blue-capped Motmot (Photo by Al Barr).

At our camp site out of Pinal de Amoles I caught my net-lifer Blue-capped Motmot (*Momotus coeruliceps*; Fig. 6) in a mist net set near the river. Dr. Arnold instructed me to dispatch it, and prepare the skin for the TCWC!

Spent most of the day 7 January preparing a Red-tailed Hawk (*Buteo jamaicensis*) Dr. Arnold collected, while Al spent the day preparing a raven also from Dr. Arnold. These specimens were collected from another location referenced as "México: San Luis Potosí, Rancho Capulin" that Arnold and Dixon, and I believe Mr. Sharpton, visited by vehicle.

The following day Al and I protested against preparing more specimens in a discussion with Drs. Arnold and Dixon. We, along with Barbara Nagle, packed a lunch and went to the river to birdwatch and swim most of the day. The trip was a great adventure with many lifer birds, new habitats and a fun crew.

I am so grateful for the leadership of Drs. Arnold and Dixon that made this trip possible. I learned a great deal from all on the trip and had a great time.

Robert A. Thomas (73-74 expedition)
Northeast México in the early 1970s was a mystical place for a young biologist who was developing a passion for tropical ecology. The field trip under discussion was my third trip to that part of the world and the excitement mounted due to being led by Drs. Arnold and Dixon, both of whom had years of experience with the Mexican and other Neotropical biota.

One never knows what adventures lie ahead on a field trip, but an important element in the tropical biologist's tool box is a target list. The less experienced field person normally has the longest target list; the more experienced has a shorter list, but the targets are usually more difficult to find. Major lures of the tropics are the pursuit of new discoveries and observations, and the treat is the unexpected encounter. Although finding your targets is most fulfilling, the simple realization that you shared the ecosystem with them and that they may have watched you is plenty for your soul – and it guarantees you will be back in full pursuit.

A major stimulus for success with a target list is the pressure and competitive atmosphere created by the expedition leadership, and Arnold and Dixon never failed in this arena. They knew their target lists, and they knew the list of each of their students. There was continual friendly (but real) banter about who found what, a clear message that success would earn prestige among the members of the field crew.

Due to having taken Arnold's graduate ornithology class, I knew a broad target would be learning as much as possible about Mexican birds. This was a major task for a herpetologist who is normally digging around on the ground for reptiles and amphibians. But the enthusiasm of Keith and his students encouraged me to spend many hours birdwatching. I registered 80 species of birds, most of which were lifers for me. This excited atmosphere was the beginning of a lifelong love of birdwatching throughout the Neotropics, and all seven continents. Thanks Dr. Arnold, Al Barr, Cal Newnam and Fred Collins!

At the top of my reptile target list was the Jalpan tropical night lizard (*Lepidophyma occulor*) that was only known at the time from seven specimens, all collected in Querétaro - two of which were collected at night near the Sugar Mill at Ex-Hacienda Concá, then owned by the Sharpton family. Our field experience led us to believe that *L. occulor* probably walked about at night on the sugar mill walls.

Figure 7 - The former sugar mill at Ex-Hacienda Concá, Querétaro, Mexico. The large mound of dirt in the foreground was the site of capture of a Jalpan tropical night lizard (*Lepidophyma occulor*) (photo by R.A. Thomas).

While others worked the specimens collected or observed that day, journaled, and socialized, I spent a couple of hours surveying, to no avail, the rock and masonry walls of the Sugar Mill. I walked around a four foot high pile of dirt, examined it thoroughly, then noticed a hole at ground level (easily seen in Fig. 7). I knelt down, looked in with my headlamp, and saw an adult *L. occulor* staring back at me! Not bad for one trip, and I haven't mentioned all the other species found during the field studies.

ACKNOWLEDGMENTS:

Heather Prestridge and Toby Hibbitts, curators of the Biodiversity Research and Teaching Collections (formerly the Texas Cooperative Wildlife Collection) of Texas A&M University were extremely helpful and quick fielding questions and supplying data on the specimens from the expeditions. They also examined some specimens and confirmed their identification for the paper. Al Barr contributed his memories and photos of the Mexican field trips with Dr. Arnold. Dale Knuse, curator of the Tracy Herbarium at Texas A&M, helped with plant identification. Mac Womac helped with photo processing, Linda Martin-Rust typed the manuscript, Kendra

Kocab prepared tables (including checking most recent taxonomy) and maps, and both her and Megan Ahlgren helped with editing. Special thanks to Dan Brooks of the Houston Museum of Natural Science for his vision and assistance with resurrecting 45 year old data and making it a timely contribution to ornithological history.

Figure 8 – Students look on as Arnold changes a flat tire (Photo by R.A. Thomas).

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Appendix 1 - Northern limits of Neotropical genera and species by river system within the Tamaulipan Biotic Province from south to north

River	Genera	Species	Common Name
PANUCO	*Leptodon*	*Leptodon cayanensis*	Gray-headed Kite
		Buteo brachyurus	Short-tailed Hawk
		Leptotila rufaxilla	Gray-fronted Dove
		Trogon violaceus	Guianan Trogan
		Trogon melanocephalus	Black-headed Trogon
		Ara macao	Scarlet Macaw
		Lepidocolaptes leucogaster	White-striped Woodcreeper
		Tyrannus melancholicus	Tropical Kingbird
		Tityra inquisitor	Black-crowned Tityra
	Cyanerpes	*Cyanerpes cyaneus*	Red-legged Honeycreeper
		Habia rubica	Red-crowned Ant-Tanager
	Dives	*Dives dives*	Melodious Blackbird
	Psarocolius	*Psarocolius montezuma*	Montezuma Oropendula
TAMESI/GUAYALEJO	*Dactylortyx*	*Dactylortyx thoracicus*	Singing Quail
	Spizaetus	*Spizaetus ornatus*	Ornate Hawk-Eagle
		Ictinia plumbea	Plumbeous Kite
	Geranospiza	*Geranospiza caerulescens*	Crane Hawk
		Columbina talpacoti	Ruddy Ground-Dove
	Claravis	*Claravis pretiosa*	Blue Ground-Dove
	Piaya	*Piaya cayana*	Squirrel Cuckoo
		Megascops guatemalae	Vermiculated Screech-Owl
		Antrostomus salvini	Tawny-collared Nightjar
	Nyctibius	*Nyctibius griseus*	Common Potoo
	Streptoprocne	*Streptoprocne zonaris*	White-collared Swift
	Chlorostilbon	*Chlorostilon canivetii*	Canivet's Emerald
	Campylopterus	*Campylopterus curvipennis*	Wedge-tailed Sabrewing
		Amazilia candida	White-bellied Emerald
		Amazilia cyanocephala	Azure-crowned Hummingbird
	Hylocharis	*Hylocharis leucotis*	White-eared Hummingbird
		Chloroceryle amazona	Amazon Kingfisher
	Picoides	*Picoides fumigatus*	Smoky-brown Woodpecker
	Herpetotheres	*Herpetotheres cachinnans*	Laughing Falcon
	Pionus	*Pionus senilis*	White-crowned Parrot
		Eupsittula nana	Olive-throated Parakeet

	Ara	*Ara militaris*	Military Macaw
	Thamnophilus	*Thamnophilus doliatus*	Barred Antshrike
	Sittasomus	*Sittasomus griseicapillus*	Olivaceous Woodcreeper
	Xiphorhynchus	*Xiphorhynchus flavigaster*	Ivory-billed Woodcreeper
	Lepidocolaptes	*Lepdiocolaptes affinis*	Spot-crowned Woodcreeper
	Myiopagis	*Myiopagis viridicata*	Greenish Elaenia
	Mitreohanes	*Mitrephanes phaeocercus*	Tufted Flycatcher
		Contopus pertinax	Greater Pewee
		Empidonax albigularis	White-throated Flycatcher
	Megarynchus	*Megarynchus pitangua*	Boat-billed Flycatcher
	Myiozetetes	*Myiozetetes similis*	Social Flycatcher
		Myiodynastes maculatus	Streaked Flycatcher
	Tityra	*Tityra semifasciata*	Masked Tityra
		Pachyramphus major	Gray-collared Becard
	Cyclarhis	*Cyclarhis gujanensis*	Rufous-browed Peppershrike
		Tachycineta albilinea	Mangrove Swallow
	Uropsila	*Uropsila leucogastra*	White-bellied Wren
	Henicorhina	*Henicorhina leucosticta*	White-breasted Wood-Wren
		Catharus mexicanus	Black-headed Nightingale-Thrush
		Turdus assimilis	White-throated Thrush
	Melanotis	*Melanotis caerulescens*	Blue Mockingbird
		Geothlypis flavovelata	Altamira Yellowthroat
	Basileuterus	*Basileuterus lachrymosus*	Fan-tailed Warbler
	Thraupis	*Thraupis abbas*	Yellow-winged Tanager
	Volatinia	*Volatinia jacarina*	Blue-black Grassquit
	Tiaris	*Tiaris olivaceus*	Yellow-faced Grassquit
	Saltator	*Saltator atriceps*	Black-headed Saltator
		Saltator coeruescens	Grayish Saltator
		Piranga bidentata	Flam-colored Tanager
		Piranga leucoptera	White-winged Tanager
	Habia	*Habia fuscicauda*	Red-throated Ant-Tanager
	Amblycercus	*Amblycercus holosericeus*	Yellow-billed Cacique
	Euphonia	*Euphonia affinis*	Scrub Euphonia
		Euphonia elegantissima	Elegant Euphonia
SOTO LA MARINA	*Crypturellus*	*Crypturellus cinnamomeus*	Thicket Tinamou
	Penelope	*Penelope purpurascens*	Crested Guan
	Crax	*Crax rubra*	Great Curassow
		Buteogallus urubitinga	Great Black Hawk
		Coccyzus minor	Mangrove Cuckoo
	Ciccaba	*Ciccaba virgata*	Mottled Owl

	Anthracothorax	*Anthracothorax prevostii*	Green-breasted Mango
	Cynanthus	*Cynanthus latirostris*	Broad-billed Hummingbird
		Amazilia tzacatl	Rufous-tailed Hummingbird
	Momotus	*Momotus coeruliceps*	Blue-capped Motmot
		Dryocopus lineatus	Lineated Woodpecker
		Campephilus guatemalensis	Pale-billed Woodpecker
	Micrastur	*Micrastur semitoruatus*	Collared Forest-Falcon
		Falco rufigularis	Bat Falcon
	Amazona	*Amazona viridigenalis*	Red-crowned Parrot
		Amazona autumnalis	Red-lored Parrot
		Amazona oratrix	Yellow-headed Parrot
		Myiarchus tuberculifer	Dusky-capped Flycatcher
	Myiodynastes	*Myiodynastes luteiventris*	Sulphur-bellied Flycatcher
		Progne chalybea	Gray-breasted Martin
		Geothlypis nelsoni	Hooded Yellowthroat
		Basileuterus culicivorus	Golden-crowned Warbler
SAN FERNANDO	*Psittacara*	*Psittacara holochlorus*	Green Parakeet
		Corvus imparatus	Tamaulipas Crow
	Cyanocompsa	*Cyanocompsa parellina*	Blue Bunting
RIO GRANDE	*Ortalis*	*Ortalis vetula*	Plain Chachalaca
	Chondrohierax	*Chondrohierax uncinatus*	Hook-billed Kite
		Rupornis magnirostris	Roadside Hawk
		Buteo plagiatus	Gray Hawk
		Patagioenas flavirostris	Red-billed Pigeon
	Leptotila	*Leptotila verreauxi*	White-tipped Dove
		Amazilia yucatanensis	Buff-bellied Hummingbird
	Trogon	*Trogon elegans*	Elegant Trogon
		Megaceryle torquata	Ringed Kingfisher
	Colaptes	*Colaptes rubiginosis*	Golden-olive Woodpecker
		Tyrannus couchii	Couch's Kingbird
	Pachyramphus	*Pachyramphus aglaiae*	Rose-throated Becard
		Psilorhinus morio	Brown Jay
	Myadestes	*Myadestes occidentalis*	Brown-backed Solitaire
		Turdus grayi	Clay-colored Thrush
	Peucedramus	*Peucedramus taeniatus*	Olive Warbler
		Geothlypis poliocephala	Gray-crowned Yellowthroat
		Basileuterus rufifrons	Rufous-capped Warbler
	Sporophila	*Sporophila torqueola*	White-collared Seedeater
	Rhodothraupis	*Rhodothraupis celaeno*	Crimson-collared Grosbeak

N. OF RIO GRANDE	*Zenaida asiatica*	White-winged Dove	
	Chloroceryle	*Chloroceryle americana*	Green Kingfisher
		Falco femoralis	Aplomado Falcon
	Camptostoma	*Camptostoma imberbe*	Northern Beardless-Tyrannulet
		Myiarchus tyrannulus	Brown-crested Flycatcher
	Pitangus	*Pitangus sulphuratus*	Great Kiskadee
	Cyanocorax	*Cyanocorax yncas*	Green Jay
		Setophaga pitiayumi	Tropical Parula
	Arremonops	*Arremonops rufivirgatus*	Olive Sparrow
		Icterus graduacauda	Audubon's Oriole

Appendix 2 - Checklist of native birds of the Tamaulipan biotic region.

Family Tinamidae – Tinamous	
Crypturellus cinnamomeus, Thicket Tinamou	MA
Family Cracidae – Curassows and Guans	
Ortalis vetula, Plain Chachalaca	SP
Penelope purpurascens, Crested Guan	SP ^
Crax rubra, Great Curassow	SP ^
Family Odontophoridae – New World Quail	
Callipepla squamata, Scaled Quail	WP
Colinus virginianus, Northern Bobwhite	NP
Dactylortyx thoracicus, Singing Quail	MA ^
Cyrtonyx montezumae, Monetzuma Quail	WP ^
Family Phasianidae – Pheasants, Grouse and Allies	
Meleagris gallopavo, Wild Turkey	NP
Family Cathartidae – New World Vultures	
Coragyps atratus, Black Vulture	PA
Cathartes aura, Turkey Vulture	PA
Family Accipitridae – Kites, Eagles, Hawks and Allies	
Elanus leucurus, White-tailed Kite	PA
Chondrohierax uncinatus, Hook-billed Kite	SP
Leptodon cayanensis, Gray-headed Kite	SP
Spizaetus ornatus, Ornate Hawk-Eagle	SP ^
Ictinia plumbea, Plumbeous Kite	SP ^
Accipiter striatus, Sharp-shinned Hawk	PA
Geranospiza caerulescens, Crane Hawk	SP
Buteogallus anthracinus, Common Black Hawk	SP
Buteogallus urubitinga, Great Black Hawk	SP
Rupornis magnirostris, Roadside Hawk	SP
Parabuteo unicinctus, Harris's Hawk	SP
Geranoaetus albicaudatus, White-tailed Hawk	SP
Buteo plagiatus, Gray Hawk	MA
Buteo lineatus, Red-shouldered Hawk	NP
Buteo brachyurus, Short-tailed Hawk	SP
Buteo albonotatus, Zone-tailed Hawk	PA
Buteo jamaicensis, Red-tailed Hawk	NP
Family Columbidae – Pigeons and Doves	
Patagioenas flavirostris, Red-billed Pigeon	MA
Columbina inca, Inca Dove	MA
Columbina passerina, Common Ground-Dove	SP
Columbina talpacoti, Ruddy Ground-Dove	SP
Claravis pretiosa, Blue Ground-Dove	SP ^
Geotrygon montana Ruddy Quail-Dove	SP
Leptotila verreauxi, White-tipped Dove	SP
Leptotila plumbeiceps, Gray-headed Dove	MA ^
Zenaida asiatica, White-winged Dove	MA
Zenaida macroura, Mourning Dove	NP
Family Cuculidae – Cuckoos, Roadrunner and Anis	
Piaya cayana, Squirrel Cuckoo	SP
Coccyzus americanus, Yellow-billed Cuckoo	NP
Coccyzus minor, Mangrove Cuckoo	MA
Crotophaga sulcirostris, Groove-billed Ani	SP

Geococcyx californianus, Greater Roadrunner	WP
Family Tytonidae – Barn Owls	
Tyto alba – Barn Owl	PA
Family Strigidae – Typical Owls	
Megascops asio, Eastern Screech-Owl	NP
Megscops trichopsis, Whiskered Screech-Owl	M
Megascops guatamalae, Vermiculated Screech-Owl	SP
Bubo virginianus, Great Horned Owl	PA
Glaucidium sanchezi, Tamaulipas Pygmy-Owl	E
Glaucidium brasilianum, Ferruginous Pygmy-Owl	SP
Micrathene whitneyi, Elf Owl	WP
Athene cunicularia, Burrowing Owl	PA
Ciccaba virgata, Mottled Owl	SP
Family Caprimulgidae – Goatsuckers	
Chordeiles acutipennis, Lesser Nighthawk	PA
Chordeiles minor, Common Nighthawk	NP
Nyctidromus albicollis, Common Pauraque	SP
Phalaenoptilus nuttallii, Common Poorwill	WP
Antrostomus salvini, Tawny-collared Nightjar	C
Antrostomus arizonae, Mexican Whip-poor-will	M
Family Nyctibiidae – Potoos	
Nyctibius griseus, Common Potoo	SP
Family Apodidae – Swifts	
Streptoprocne zonaris, White-collared Swift	SP
Chaetura vauxi, Vaux's Swift	PA ^
Aeronautes saxatalis, White-throated Swift	WP
Family Trochilidae – Hummingbirds	
Anthracothorax prevostii, Green-breasted Mango	MA ^
Eugenes fulgens, Magnificent Hummingbird	MA ^
Lampornis amethystinus, Amethyst-throated Hummingbird	M ^
Atthis heloisa, Bumblebee Hummingbird	M ^
Chlorostilbon canivetii, Canivet's Emerald	MA ^
Cynanthus latirostris, Broad-billed Hummingbird	M ^
Campylopterus curvipennis, Wedge-tailed Sabrewing	MA ^
Amazilia candida, White-bellied Emerald	MA ^
Amazilia cyanocephala, Azure-crowned Hummingbird	MA ^
Amazilia tzacatl, Rufous-tailed Hummingbird	MA
Amazilia yucatanensis, Buff-bellied Hummingbird	MA
Hylocharis leucotis, White-eared Hummingbird	M ^
Family Trogonidae – Trogons	
Trogon mexicanus, Mountain Trogon	M ^
Trogon caligatus, Gartered Trogon	MA ^
Trogon elegans, Elegant Trogon	MA
Family Momotidae – Motmots	
Momotus coeruliceps, Blue-capped Motmot	C
Family Alcedinidae – Kingfishers	
Ceryle torquata, Ringed Kingfisher	SP
Chloroceryle amazona, Amazon Kingfisher	SP
Chloroceryle americana, Green Kingfisher	SP
Family Picidae – Woodpeckers	
Melanerpes formicivorus, Acorn Woodpecker	WP ^
Melanerpes aurifrons, Golden-fronted Woodpecker	M
Picoides scalaris, Ladder-backed Woodpecker	WP
Picoides fumigatus, Smoky-brown Woodpecker	SP ^
Picoides villosus, Hairy Woodpecker	NP
Colaptes rubiginosus, Golden-olive Woodpecker	SP

Dryocopus lineatus, Lineated Woodpecker	SP
Campephilus guatemalensis, Pale-billed Woodpecker	MA
Family Falconidae – Falcons and Caracaras	
Micrastur semitorquatus, Collared Forest-Falcon	SP
Caracara cheriway, Crested Caracara	SP
Herpetotheres cachinnans, Laughing Falcon	SP
Falco sparverius, American Kestrel	PA
Falco femoralis, Aplomado Falcon	SP
Falco rufigularis, Bat Falcon	SP
Family Psittacidae – Lories, Parakeets, Macaws and Parrots	
Pionus senilis, White-crowned Parrot	MA ^
Amazona viridigenalis, Red-crowned parrot	E
Amazona autumnalis, Red-lored Parrot	SP
Amazona oratrix, Yellow-headed Parrot	M
Eupsittula nana, Olive-throated Parakeet	MA
Ara militaris, Military Macaw	SP ^
Ara macao, Scarlet Macaw	SP
Psittacara holochlorus, Green Parakeet	M
Family Thamnophilidae – Typical Antbirds	
Thamnophilus doliatus, Barred Antshrike	SP ^
Family Furnariidae – Ovenbirds and Woodcreepers	
Sittasomus griseicapillus, Olivaceous Woodcreeper	SP ^
Xiphorhynchus flavigaster, Ivory-billed Woodcreeper	MA
Lepidocolaptes affinis, Spot-crowned Woodcreeper	MA
Family Tyrannidae – Tyrant Flycatchers	
Camptostoma imberbe, Northern Beardless-Tyrannulet	MA
Myiopagis viridicata, Greenish Elaenia	SP ^
Mitrephanes phaeocercus, Tufted Flycatcher	MA ^
Contopus pertinax, Greater Pewee	WP ^
Contopus sordidulus, Western Wood-Pewee	WP ^
Empidonax albigularis, White-throated Flycatcher	MA ^
Empidonax occidentalis, Cordilleran Flycatcher	WP
Sayornis nigricans, Black Phoebe	PA
Sayornis saya, Say's Phoebe	WP
Pyrocephalus rubinus, Vermilion Flycatcher	PA
Myiarchus tuberculifer, Dusky-capped Flycatcher	SP
Myiarchus cinerascens, Ash-throated Flycatcher	WP
Myiarchus tyrannulus, Brown-crested Flycatcher	SP
Pitangus sulphuratus, Great Kiskadee	SP
Megarynchus pitangua, Boat-billed Flycatcher	SP
Myiozetetes similis, Social Flycatcher	SP
Myiodynastes maculatus, Streaked Flycatcher	SP ^
Myiodynastes luteiventris, Sulphur-bellied Flycatcher	MA
Tyrannus melancholicus, Tropical Kingbird	SP
Tyrannus couchii, Couch's Kingbird	C
Tyrannus vociferans, Cassin's Kingbird	WP ^
Tyrannus forficatus, Scissor-tailed Flycatcher	NP
Family Tityridae	
Tityra semifasciata, Masked Tityra	SP ^
Pachyramphus major, Gray-collared Becard	M ^
Pachyramphus aglaiae, Rose-throated Becard	MA
Family Laniidae – Shrikes	
Lanius ludovicianus, Loggerhead Shrike	N
Family Vireonidae – Vireos	
Cyclarhis gujanensis, Rufous-browed Peppershrike	SP ^
Vireo griseus, White-eyed Vireo	NP

Vireo belli, Bell's Vireo	NP
Vireo huttoni, Hutton's Vireo	WP
Vireo leucophrys, Brown-capped Vireo	SP ^
Vireo flavoviridis, Yellow-green Vireo	MA
Family Corvidae – Crows, Jays and Magpies	
Psilorhinus morio, Brown Jay	MA
Cyanocorax yncas, Green Jay	SP
Aphelocoma wollweberi, Mexican Jay	M ^
Corvus imparatus, Tamaulipas Crow	C
Corvus cryptoleucus, Chihuahuan Raven	WP
Corvus corax, Common Raven	NP ^
Family Alaudidae – Larks	
Eremophila alepstris, Horned Lark	NP
Family Hirundinidae – Swallows	
Stelgidopteryx serripennis, Northern Rough-winged Swallow	NP ^
Progne subis, Purple Martin	NP
Progne chalybea, Gray-breasted Martin	SP ^
Tachycineta albilinea, Mangrove Swallow	MA
Tachycineta thalassina, Violet-green Swallow	WP
Riparia riparia, Bank Swallow	NP
Hirundo rustica, Barn Swallow	PA
Petrochelidon pyrrhonota, Cliff Swallow	NP
Petrochelidon fulva, Cave Swallow	WP ^
Family Paridae – Tits, Chickadees and Titmice	
Baeolophus atricristatus, Black-crested Titmouse	NP
Family Remizidae – Penduline-Tits and Verdins	
Auriparus flaviceps, Verdin	WP
Family Troglodytidae – Wrens	
Salpinctes obsoletus, Rock Wren	WP
Catherpes mexicanus, Canyon Wren	WP
Troglodytes aedon, House Wren	PA
Thryothorus ludovicianus, Carolina Wren	NP
Thryomanes bewickii, Bewick's Wren	NP
Campylorhynchus zonatus, Band-backed Wren	MA
Campylorhynchus gularis, Spotted Wren	M ^
Campylorhynchus brunneicapillus, Cactus Wren	WP
Pheugopedius maculipectus, Spot-breasted Wren	MA
Uropsila leucogastra, White-bellied Wren	M
Henicorhina leucosticta, White-breasted Wood-Wren	SP ^
Hencorhina leucophrys, Gray-breasted Wood-Wren	SP ^
Family Polioptilidae - Gnatcatchers	
Polioptila caerulea, Blue-gray Gnatcatcher	NP
Polioptila melanura, Black-tailed Gnatcatcher	WP
Family Turdidae – Thrushes and Allies	
Sialia sialis, Eastern Bluebird	NP ^
Myadestes occidentalis, Brown-backed Solitaire	M ^
Catharus aurantiirostris, Orange-billed Nightingale-Thrush	MA
Catharus occidentalis, Russet Nightingale-Thrush	M
Catharus mexicanus, Black-headed Nightingale-Thrush	MA ^
Turdus infuscatus, Black Thrush	M ^
Turdus grayi, Clay-colored Thrush	MA
Turdus assimilis, White-throated Thrush	MA ^
Turdus migratorius, American Robin	NP ^
Family Mimidae – Mockingbirds, Thrashers and Allies	
Melanotis caerulescens, Blue Mockingbird	M ^
Toxostoma curvirostre, Curve-billed Thrasher	WP

Toxostoma longirostre, Long-billed Thrasher	C
Mimus polyglottos, Northern Mockingbird	NP
Family Ptiliogonatidae – Silky-flycatchers	
Ptiliogonys cinereus, Gray Silky-flycatcher	M ^
Phainopepla nitens, Phainopepla	WP ^
Family Peucedramidae – Olive Warbler	
Peucedramus taeniatus, Olive Warbler	MA ^
Family Parulida – New World Warblers	
Oreothlypis superciliosa, Crescent-chested Warbler	M ^
Geothlypis poliocephala, Gray-crowned Yellowthroat	MA
Geothlypis flavovelata, Altamira Yellowthroat	E
Geothlypis trichas, Common Yellowthroat	NP
Geothlypis nelsoni, Hooded Yellowthroat	M
Setophaga pitiayumi, Tropical Parula	SP
Setophaga petechia, YellowWarbler	PA
Basileuterus lachrymosus, Fan-tailed Warbler	M ^
Basileuterus rufifrons, Rufous-capped Warbler	MA
Basileuterus belli, Golden-browed Warbler	M ^
Basileuterus culicivorus, Golden-crowned Warbler	SP ^
Myioborus pictus, Painted Redstart	M ^
Icteria virens, Yellow-breasted Chat	NP
Family Thraupidae – Tanagers and Allies	
Thraupis abbas, Yellow-winged Tanager	MA ^
Cyanerpes cyaneus, Red-legged Honeycreeper	SP ^
Saltator atriceps, Black-headed Saltator	MA ^
Saltator coerulescens, Grayish Saltator	SP
Family Emberizidae – Buntings and New World Sparrows	
Volatinia jacarina, Blue-black Grassquit	SP
Sporophila torqueola, White-collared Seedeater	MA
Tiaris olivaceus, Yellow-faced Grassquit	MA
Peucaea botterii, Botteri's Sparrow	MA
Peucaea cassinii, Cassin's Sparrow	NP
Arremonops rufivirgatus, Olive Sparrow	MA
Spizella passerina, Chipping Sparrow	NP
Amphispiza bilineata, Black-throated Sparrow	WP
Chondestes grammacus, Lark Sparrow	NP
Melozone fusca, Canyon Towhee	WP
Aimophila rufescens, Rusty Sparrow	MA
Aimophila ruficeps, Rufous-crowned Sparrow	WP
Pipilo maculatus, Spotted Towhee	WP
Atlapetes pileatus, Rufous-capped Brushfinch	M ^
Family Cardinalidae – Cardinals and Allies	
Piranga flava, Hepatic Tanager	PA ^
Piranga bidentata, Flame-colored Tanager	MA ^
Piranga leucoptera, White-winged Tanager	SP ^
Habia rubica, Red-crowned Ant-Tanager	SP ^
Habia fuscicauda, Red-throated Ant-Tanager	MA ^
Rhodothraupis celaeno, Crimson-collared Grosbeak	C
Cardinalis cardinalis, Northern Cardinal	NP
Cardinalis sinuatus, Pyrrhuloxia	WP
Pheucticus mealnocephalus, Black-headed Grosbeak	WP ^
Cyanocompsa parellina, Blue Bunting	M
Passerinaa caerulea, Blue Grosbeak	NP
Passerina versicolor, Varied Bunting	M
Passerina ciris, Painted Bunting	NP
Family Icteridae – Blackbirds and Allies	

Agelaius phoeniceus, Red-winged Blackbird	NP
Sturnella neglecta, Western Meadowlark	WP
Sturnella magna, Eastern Meadowlark	PA
Dives dives, Melodious Blackbird	MA
Quiscalus mexicanus, Great-tailed Grackle	MA
Molothrus aeneus, Bronzed Cowbird	MA
Molothrus ater, Brown-headed Cowbird	NP
Icterus spurius, Orchard Oriole	NP
Icterus cucullatus, Hooded Oriole	WP
Icterus gularis, Altamira Oriole	MA
Icterus graduacauda, Audubon's Oriole	M
Amblycercus holosericeus, Yellow-billed Cacique	SP
Psarocolius Montezuma, Montezuma Oropendula	MA
Family Fringillidae – Finches, Euphonias and Allies	
Euphonia affinis, Scrub Euphonia	MA
Euphonia hirundinacea, Yellow-throated Euphonia	MA
Euphonia elegantissima, Elegant Euphonia	MA^
Haemorhous *mexicanus*, House Finch	WP ^
Loxia curvirostra, Red Crossbill	NP ^
Spinus notatus, Black-headed Siskin	M ^
Spinus psaltria, Lesser Goldfinch	PA
Coccothraustes abeillei, Hooded Grosbeak	M ^

The symbol following the common name represents the distributional status of the species in the region, where PA = Pan American, SP = southern peripheral, NP = northern peripheral, WP = western peripheral, MA = Middle American, M = Mexican, C = core species, E = endemic species; ^ = Breeds above 650 m asl.

Appendix 3 - Endemic subspecies in the Tamaulipan Biotic Province*

Family Cracidae – Curassows and Guans	
Ortalis vetula mccalli, Plain Chachalaca	SP
Family Odontophoridae – New World Quail	
Callipepla squamata castanogastris, Scaled Quail	WP
Family Strigidae – Typical Owls	
Megascops asio mccallii, Eastern Screech-Owl	NP
Micrathene whitneyi idonea, Elf Owl	WP
Ciccaba virgata tamaulipensis, Mottled Owl	SP
Family Caprimulgidae – Goatsuckers	
Chordeiles minor aserriensis, Common Nighthawk	NP
Family Apodidae – Swifts	
Chaetura vauxi tamaulipensis, Vaux's Swift	PA
Family Trochilidae – Hummingbirds	
Amazilia yucatanensis chalconota, Buff-bellied Hummingbird	MA
Family Psittacidae – Lories, Parakeets, Macaws and Parrots	
Eupsittula nana vicinalis, Olive-throated Parakeet	SP
Family Furnariidae – Ovenbirds and Woodcreepers	
Lepidocolaptes affinis lignicida, Spot-crowned Woodcreeper	MA^
Family Tyrannidae – Tyrant Flycatchers	
Pitangus sulphuratus texanus, Great Kiskadee	SP
Family Tityridae	
Pachyramphus aglaiae gravis, Rose-throated Becard	MA
Family Troglodytidae – Wrens	
Thryothorus ludovicianus lomitensis, Carolina Wren	NP
Thryothorus ludovicianus berlandieri, Carolina Wren	NP
Thryothorus ludovicianus tropicalis, Carolina Wren	NP
Pheugopedius maculipectus microstictus, Spot-breasted Wren	MA
Family Mimidae – Mockingbirds, Thrashers and Allies	
Toxostoma curvirostre oberholseri, Curve-billed Thrasher	WP
Toxostoma longirostre sennetti, Long-billed Thrasher	C
Family Parulida – New World Warblers	
Geothlypis poliocephala ralphi, Gray-crowned Yellowthroat	MA
Geothlypis trichas insperata, Common Yellowthroat	NP
Basileuterus culicivorus brasierii, Golden-crowned Warbler	SP^
Family Emberizidae – Buntings and New World Sparrows	
Sporophila torqueola sharpei, White-collared Seedeater	MA
Arremonops rufivirgatus ridgwayi, Olive Sparrow	MA^
Family Cardinalidae – Cardinals and Allies	
Cyanocompsa parellina beneplacita, Blue Bunting	M
Family Icteridae – Blackbirds and Allies	
Agelaius phoeniceus megapotamus, Red-winged Blackbird	NP
Sturnella magna hoopesi, Eastern Meadowlark	PA

* Following Friedmann et al. 1950 and Miller et al. 1957, with Clements 2016 update

The symbol following the common name represents the distributional status of the species in the region, where PA = Pan American, SP = southern peripheral, NP = northern peripheral, WP = western peripheral, MA = Middle American, M = Mexican, C = core species, E = endemic species; ^ = Breeds above 650 m asl.

Appendix 4 - Species inventory, WFS607 Field Trip to Mexico (1-5 November 1972)

SPECIES	R. Corona	R. Corona to El Salto	El Salto	El Salto	Oaks above El Naranjo	Oaks above El Naranjo
	2 Nov	2 Nov	2 Nov	3 Nov	3 Nov	4 Nov
Muscovy Duck			1	x		
Mallard				x		
Plain Chachalaca				x		
Cattle Egret		x				
Green Heron				x		
Black Vulture	x		x	x	x	
Turkey Vulture	x			x	x	
White-tailed Kite		x				
Plumbeous Kite					1	
Roadside Hawk		x				
Harris's Hawk		x				
Gray Hawk		x				
Spotted Sandpiper	1		x	x		
Red-billed Pigeon	20			x		
Common Ground-Dove	x					
White-tipped Dove	1			x	1	x
White-winged Dove				x		
Groove-billed Ani	10					
Greater Roadrunner	4					
Squirrel Cuckoo				x	1	
White-collared Swift			150	350		
Azure-crowned Hummingbird						1
hummingbird sp.			x	2	1	
Elegant Trogon				2		
Blue-capped Motmot	4			x		
Ringed Kingfisher	4			x		
Belted Kingfisher	2					
Green Kingfisher	6					
Acorn Woodpecker					4	x
Golden-fronted Woodpecker	x			x		
Yellow-bellied Sapsucker					x	
Ladder-backed Woodpecker				x		
Golden-olive Woodpecker				1	2	
Lineated Woodpecker	2					
Collared Forest-Falcon				1		
Crested Caracara	2			x		
Bat Falcon			2	2		

Falco sp.				1	
Red-crowned Parrot	50	x	x		2
Red-lored Parrot	10		x		2
Yellow-headed Parrot	50	50	x		
Green Parakeet			x		
Olivaceous Woodcreeper				1	
Ivory-billed Woodcreeper				1	
Spot-crowned Woodcreeper				1	
Greater Pewee				1	x
Empidonax sp.			2	x	
Black Phoebe		x	x		
Eastern Phoebe	x			x	
Great Kiskadee	x		x		
Boat-billed Flycatcher			1		
Social Flycatcher			4	8	x
Tropical/Couch's Kingbird			x	x	x
Masked Tityra			1		
Gray-collared Becard				1	x
Rose-throated Becard	4				
Rufous-browed Peppershrike				1	
Blue-headed Vireo			x	x	x
Brown Jay	x	x	x		x
Green Jay	1		x	4	x
Tamaulipas Crow	25		x		
Northern Rough-winged Swallow			150		
Black-crested Titmouse			x		
House Wren	4	x	x		
Carolina Wren	1				
Spot-breasted Wren			x	2	
Blue-gray Gnatcatcher	x		x	x	x
Ruby-crowned Kinglet	x		x	x	x
Western Bluebird				4	
Brown-backed Solitaire				1	
Swainson's Thrush					1
Wood Thrush				1	2
Clay-colored Thrush				x	x
White-throated Thrush		x			x
American Robin				1	
Blue Mockingbird		1	x		
Gray Catbird			x		
Long-billed Thrasher	2			4	x
Northern Mockingbird	x				
Blue-winged Warbler			x		
Black-and-white Warbler	5		x	6	x
Crescent-chested Warbler				2	1

Nashville Warbler			x	x	1	
Northern Parula					3	
Tropical Parula				x	4	
Yellow-rumped Warbler	1				2	
Yellow-throated Warbler					1	
Townsend's Warbler					6	x
Hermit Warbler					1	
Black-throated Green Warbler	2		x	x	30	
Fan-tailed Warbler				x		
Rufous-capped Warbler				x	2	1
Golden-crowned Warbler				x		
Wilson's Warbler	1		x	x	2	
Painted Redstart					3	3
White-collared Seedeater						x
Yellow-faced Grassquit						x
Chestnut-capped Brushfinch					1	
Song Sparrow			1			
Lincoln's Sparrow					2	x
Rusty Sparrow					1	
White-winged Tanager					12	x
Red-throated Ant-Tanager					1	
Black-headed Grosbeak						x
Melodious Blackbird			1	x	2	x
Altamira Oriole	1			x	2	x
Audubon's Oriole			3	x	1	
Baltimore Oriole				x	1	
Yellow-throated Euphonia			1		1	
Elegant Euphonia					4	
Black-headed Siskin					4	
Lesser Goldfinch					12	
Hooded Grosbeak					4	

Appendix 5 - Species inventory, WFS 485/685 Tropical Ecology Field Trip To Mexico (28 December 1973 - 10 January 1974)

SPECIES	R. Corona	El Salto	El Salto	W of El Lobo	W of El Lobo	N of Pinal de Amoles	E of Pinal de Amoles	El Trapiche	El Trapiche	S of Concá	S of Concá	S of Concá	W of Ciudad Valles
	Dec 29	Dec 29	Dec 30	Dec 31	Jan 1	Jan 2	Jan 3	Jan 4	Jan 5	Jan 6	Jan 7	Jan 8	Jan 9
Double-crested Cormorant	x		x										
Great Blue Heron	x												
Cattle Egret			40										
Black Vulture	x	x	x						x		x		
Turkey Vulture	x	x	x		x								
Harris's Hawk	x												
Gray Hawk	x												
Red-tailed Hawk										s			
Killdeer	x												
Spotted Sandpiper			x					x	s				
Red-billed Pigeon		x						x					
Inca Dove								x	x				
White-tipped Dove	x								s	x			
White-winged Dove								x		x			
Groove-billed Ani										x			
Greater Roadrunner						x							
Vermiculated Screech-Owl				x	s								
Northern Pygmy-Owl						x							
Mexican Whip-poor-will					x		s						
Broad-billed Hummingbird									s				
hummingbird sp.									x				
Elegant Trogon	x												
Blue-capped Motmot									s	x			
Ringed Kingfisher	x	x	x										
Belted Kingfisher	x								x				
Green Kingfisher	x	x	x										
Acorn Woodpecker				x	x								

Golden-fronted Woodpecker	x										x		x		x			s		
Yellow-bellied Sapsucker	x				x		x								s					
Ladder-backed Woodpecker	?																			
Hairy Woodpecker					x		x													
Golden-olive Woodpecker				s			x													s
Northern Flicker							x		x											
Collared Forest-Falcon																		x		
Crested Caracara	x																			
American Kesterel	x						x			x	x		x		x					
Bat Falcon		x		x																
Red-crowned Parrot	x			x																
Red-lored Parrot	x																			
Yellow-headed Parrot	x	x																		
Military Macaw		x		x																
Green Parakeet	x	x		x																
Olivaceous Woodcreeper							s													
Ivory-billed Woodcreeper																				s
Spot-crowned Woodcreeper				x			x													
Tufted Flycatcher											s									
Greater Pewee										s										
Least Flycatcher													s							
Hammond's Flycatcher													s							
Cordilleron Flyvatcher																s				
Empidonax sp.	x												x							
Black Phoebe		x		x									x							
Eastern Phoebe											x		s							
Vermillion Flycatcher															x					
Dusky-capped Flycatcher													s							
Brown-crested Flycatcher													s							
Great Kiskadee	x	x													x					
Boat-billed Flycatcher													s		x					
Social Flycatcher		x													x			s		
Cassin's Kingbird																		s		
Western Kingbird															x					
Chestnit-sided Shrike-Vireo							s													

Blue-headed Vireo		x										
Brown Jay	x		x									
Mexican Jay				x	x	x	x					
Tamaulipas Crow	x	x	x									
Common Raven									x	s		
Violet-green Swallow		x	x									
swallow sp.			x									
Bridled Titmouse					x							
Black-crested Titmouse	x											
Canyon Wren							s					
House Wren												s
Spotted Wren							x*					
Gray-breasted Wood-Wren					s							
Blue-gray Gnatcatcher	x								x		s	
Ruby-crowned Kinglet	x			x	x	x			x			
Eastern Bluebird								s				
Western Bluebird							x					
Swainson's Thrush		s										
Hermit Thrush					s	s						
Clay-colored Thrush	x		s		s	s				x	s	
White-throated Thrush												
American Robin	x				s							
Northern Mockingbird									s			
Cedar Waxwing												s
Louisiana Waterthrush									s			
Black-and-white Warbler	x	x					x		x	x		
Crescent-chested Warbler						x						
Nashville Warbler										s		
Common Yellowthroat										x		
Tropical Parula									s			
Yellow-rumped Warbler	x		x	x			x		s			
Townsend's Warbler						x	s					
Hermit Warbler				x	x	x	s		x			
Golden-cheeked Warbler					x							
Black-throated Green Warbler									x			

Rufous-capped Warbler					x			x*					s					s
Golden-browed Warbler							x											
Golden-crowned Warbler	x																	s
Wilson's Warbler							x		x		x		s		x		x	
Painted Redstart					x						s		s					
Slate-throated Redstart									x									
Olive Sparrow															x		s	
Chipping Sparrow											x							
Chestnut-capped Brushfinch							x											
Canyon Towhee											x							
Spotted Towhee											x							
Summer Tanager											x							
Western Tanager																	s	
Flame-colored Tanager																x		
Crimson-collared Grosbeak																x	s	
Black-headed Grosbeak					x		x						s					
Melodious Blackbird																s	x	
Great-tailed Grackle	x		x															
Altamira Oriole	x				x											x		s
Audubon's Oriole					x		s									x		s
Scrub Euphonia																x		x
Elegant Euphonia					s		s											
House Finch													s					
Black-headed Siskin							x				x							

x = sight record, s = specimen collected, * = seen at same location following day.

AVIAN ART

A new look at colonial naturalist Mark Catesby

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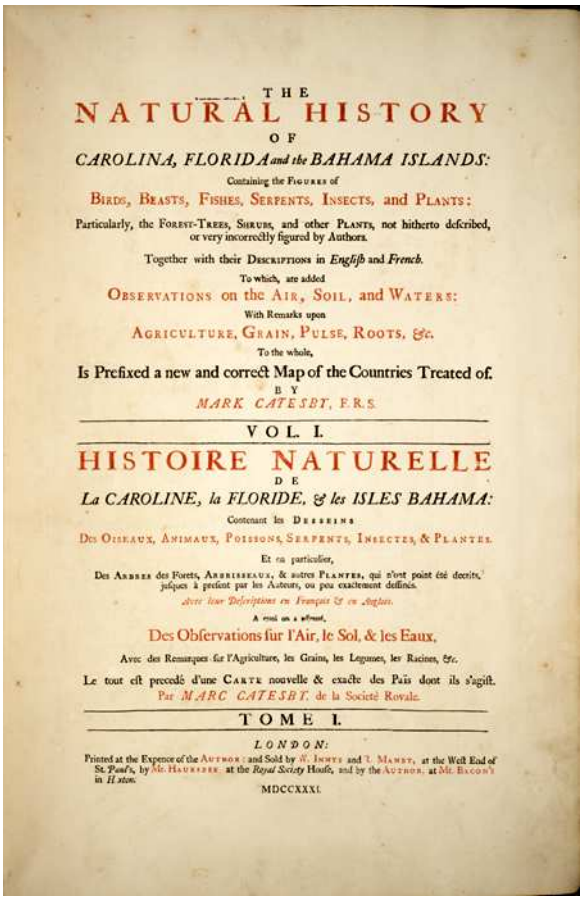
On a beautiful day in late September, 1712, at Westover, the vast estate of William Byrd II on the James River, some twenty miles from Williamsburg, Byrd was aroused from his usual afternoon session in his private library by a guest, Mark Catesby (1682/83-1749), a well-to-do thirty-year-old English naturalist new to the Virginia colony. The visitor had sighted a bear. The New World career of the most important American natural history illustrator of the 18th century was off to a rousing start.

My interest in Mark Catesby dates back to my days as a young boy growing up in the southeast, when I put myself to the task of learning the scientific names of the fauna of the region. Among the first names I encountered was *Rana catesbeiana*, the bullfrog, whose vibrant, bass bellowing filled the moonlit nights of spring and early summer. At the time there was virtually no available literature on Catesby and it was some time later that I learned that it was Mark Catesby who first brought this marvelous creature to the attention of the world through his beautiful painting of this species with the pink lady's-slipper (Fig. 1), and that the bullfrog was later, in 1802, named for him as a fitting and lasting memorial.

Figure 1 - Catesby's Bullfrog (Volume II, Plate 72), (*Lithobates [Rana] catesbeiana*), bearing his name, and the Pink Lady's-slipper, is among Catesby's most remarkable paintings of amphibians.

In 1961 Frick and Stearns in their classic book Mark Catesby: the Colonial Audubon, reintroduced the public to this remarkable naturalist. Catesby's Natural History of Carolina, Florida and the Bahama Islands (1731-1743 [1748], Fig. 2) included 220 plates of birds, reptiles and amphibians, fish, insects, and mammals, as well as a remarkable array of plants, and

remained the most authoritative work on ornithology until the publication of Alexander Wilson's American Ornithology in 1808-1814, a monumental ten volume work that depicted 268 species of birds with extensive descriptions, an accomplishment which deservedly earned him the title Father of American Ornithology. However, both Catesby and Wilson fell into obscurity by the Herculean efforts of the genius John James Audubon, who rendered double elephant folio paintings of 435 birds, all in natural settings (published between 1827-1838). His revolutionary use of life-like natural poses eclipsed all previous artistic rendering of the natural world and his life-size portrayals provided an artistic work so dazzling that all before quickly fell into obscurity; Audubon's long shadow darkened the endeavors of all who had come before. The subtitle of Frick and Stearns' book, the Colonial Audubon, had the unfortunate effect of rendering Catesby a primitive form of Audubon, which may in part explain the fact that he has been so ignored. In fact, Catesby clearly stands on his own as a natural history scientist and scholar, and an artist who created a new, historically pivotal, natural history art form.



THE
NATURAL HISTORY
OF
CAROLINA, FLORIDA and the BAHAMA ISLANDS:
Containing the Figures of
Birds, Beasts, Fishes, Serpents, Insects, and Plants:
Particularly, the Forest-Trees, Shrubs, and other Plants, not hitherto described, or very incorrectly figured by Authors.
Together with their Descriptions in *English* and *French*.
To which, are added
Observations on the Air, Soil, and Waters:
With Remarks upon
Agriculture, Grain, Pulse, Roots, &c.
To the whole,
Is Prefixed a new and correct Map of the Countries Treated of.
BY
MARK CATESBY, F.R.S.
VOL. I.
HISTOIRE NATURELLE
DE
La CAROLINE, la FLORIDE, & les ISLES BAHAMA:
Contenant les Desseins
Des Oiseaux, Animaux, Poissons, Serpents, Insectes, & Plantes.
Et en particulier,
Des Arbres des Forets, Arbrisseaux, & autres Plantes, qui n'ont point été decrits, jusques à present par les Auteurs, ou peu exactement dessinés.
Avec leur Descriptions en François & en Anglois.
A quoi on a ajouté,
Des Observations sur l'Air, le Sol, & les Eaux,
Avec des Remarques sur l'Agriculture, les Grains, les Legumes, les Racines, &c.
Le tout est precedé d'une Carte nouvelle & exacte des Païs dont ils s'agist.
Par MARC CATESBY, de la Societé Royale.
TOME I.
LONDON:
Printed at the Expence of the Author: and Sold by W. Innys and T. Manby, at the West End of St. Paul's, by Mr. Haubert, at the *Royal Society* House, and by the Author, at Mr. Bacon's in *Hoxton*.
MDCCXXXI.

Figure 2 - Frontispiece of Catesby's Natural History (from collection of Alan Feduccia).

In 1985 I published my book on Catesby's Birds of Colonial America, and University of North Carolina Press was surprised at the brisk sales of the volume, which is still available in paperback. The book proved to be the beginning of an intense interest in the colonial naturalist. More recently, the revival of Mark Catesby has continued with the discovery of the watercolors in Windsor Castle that were purchased by King George III in 1768, and the subsequent book on the watercolors and traveling exhibit in the United States and in London. In 2008 a documentary film, The Curious Mister Catesby emerged, envisioned and guided by the capable hands of David Elliott, and Producer/Director Cynthia Neal; and in 2015 a collection of essays on Catesby was published in book form by the University of Georgia Press, edited by Charles Nelson and David Elliott (see refs.). This work is particularly noted for its nicely compiled botanical information, appropriately, since Mark Catesby was first and foremost a botanist.

When we think of Catesby today, we automatically think of birds--everybody's favorite among the animal world. Evolutionary biologist Ernst Mayr called the study of birds *sciencia amabilis*, the beautiful science, pointing to its contribution to myriad fields of biology. So, Catesby is known mainly to the public for his paintings of birds, but as noted above he was primarily a botanist, for in his time in England botany was the ruling science. It is interesting to note that many of Catesby's paintings are of medicinally or nutritionally useful plants. For example ginseng, painted with the whip-poor-will, was widely known as a curative for fatigue, an

aphrodisiac, and even used in the treatment of diabetes. As Catesby noted, "it is certain that it increases the motion of and warms the blood, that it helps digestion, and invigorates in a very sensible manner." Other notable examples include the ground dove with the Hercules-club or tooth-ache tree, used as an astringent for tooth-ache, the Mourning Dove with the May apple, an excellent emetic, and the dead robin with the snakeroot, a plant thought to be a cure for snakebite (Fig. 3).

Figure 3 - Catesby's bird art includes examples of associations of plant and animal illustrating Indian lore and myth, as well as medicinal use. Below, the American Robin (I,29), lying dead on the Snakeroot; and the Whip-poor-will (Appen. II,16), associated with the Ginseng, which likely reflects the fact that the Indians had mystical views of the Whip-poor-will.

Botanical science was essentially provided the medicine of the day, apothecary science, much as it is even today in various remote regions of the world. Samuel Dale had published his famous Pharmacologica in 1693, but the continued pre-eminence of medical botany is vividly illustrated by Jacob Bigelow's American Medical Botany. Published between1817-1820, it was the first book published in the United States to have plates printed in color, but it also shows that the science of medical botany was going strong even a hundred years after Catesby's New World ventures.

Mark Catesby was born the fifth son of gentry in 1682, educated in Essex, and from his early years had an interest in natural history, particularly botany, an interest in which he had been encouraged by numerous individuals of prominence. His parents were John Catesby, who practiced law and had considerable holdings in the area, and Elizabeth Jekyll of Castle Hedingham, who came from a prosperous local family of lawyers and antiquarians. Thus, well-born young Catesby was exposed to many of England's "new intelligentsia" who were most interested in the natural world. Nicholas Jeckyll introduced him to the prominent naturalist John Ray, who nurtured Catesby's interest in botany and further introduced him to the notable botanist Samuel Dale, who would later help finance Catesby's American collecting. But Catesby's most important family connection was with his sister Elizabeth, who had married a Dr. William Cocke, a Cambridge graduate, against the will of her father, who called her "my disobedient daughter." Speaking of his first voyage to the New World in 1712, Catesby notes that "Virginia was the Place (I having Relations there) which suited most with my Convenience to go." As a

digression, note here the similarity with the statement made by the earlier naturalist John Lawson, who traveled to America in 1700: “Carolina was the best Country I could go to.” I shall later return to this theme, use of Lawson’s book.

On April 23, 1712, Catesby arrived at Jamestowne, abandoned since 1699. Jamestowne was founded, as Dorman succinctly notes, in Adventurers of Purse and Person, by people of entrepreneurial goals (Adventurers of Purse referring to stockholders in the Virginia Company of London). It was Jamestowne, and not Plymouth (which was settled 13 years later by religious dissidents), that gave us our English laws and culture, our English language, our founding Anglican religion, and the entrepreneurial spirit that gave rise to this great country, first with tobacco (the gold of the colonial period), and later with the naval stores producing pitch, tar and turpentine for the shipping industry.

Mark Catesby must have felt some comfort of familiarity as he proceeded to the delightful capital of Virginia, Middle Plantation, the village of Williamsburg, with a population of about 2000, beautifully situated on high land between the York and James Rivers, with small Georgian houses each with a formal English garden. The exhilaration and emotions of young Catesby are encapsulated by his proclamation, “Virginia, the earthly paradise!” And it was in Williamsburg that he would be introduced to the elite in the area by his brother-in-law Dr. Cooke, who was a leading physician, member of the Governor’s Council and eventually its secretary under Governor Spotswood.

It is interesting to note here that while Mark Catesby left no New World descendants, the lineal descendents of Dr. Cooke and Elizabeth produced a truly distinguished southern family, and as the late Bob Catesby of England noted in his brilliant genealogy of the Catesby family, “Holders of the surname are proud to share it with their American cousins who use it as a Christian name. This practice has continued for two hundred years and it is as common today as at any time during this period.”

Back to Williamsburg, it was the introductions by Dr. Cocke, who had become an important force in Virginia politics, that led to Catesby’s lasting friendship with William Byrd II, a member of the Council of Virginia, with whom he would spend periods of time at the 14,000 acre Westover Plantation, discussing botany, gardening and natural history in general. With Byrd, Catesby traveled west in late May of 1712, meeting Spotswood at the Pamunkey Indian town. Catesby spent his time in Virginia (except for a trip to Jamaica in 1714) traveling through the Tidewater and up the James to the Appalachians; he sketched flora and fauna and collected botanical specimens for Dale and Thomas Fairchild, the latter owner of the well-known Hoxton nursery. Also, in 1714 he traveled west to the Virginia mountains, to the St. James River, an area visited two years later by Spotswood and company, a group later romantically dubbed “Knights of the Golden Horseshoe.” Among the “Knights” was a James Taylor II, great-grandfather of James Madison and Zachary Taylor, illustrating again the constricted group of New World elite that formed the web of the Catesby circle of acquaintances.
William Byrd II was educated in England and cut a broad swath in London society before returning to America in 1705. Byrd was elected to the Royal Society at the age of 22, without publishing and having accomplished nothing in research. He was an institution unto himself, having inherited Westover, with its magnificent setting along the James River. He has been

described variously as brilliant, vain, flamboyant, ambitious, and he could be absurdly childish. He fancied himself something of a universal genius, fostered no doubt by his provincial environment, and as Byrd's famous secret diary tells us, the entertainment and dining at Westover was lavish. When Catesby arrived with Dr. Cocke, Byrd notes, "In the evening we took a walk about the plantation and at night we drank a bottle. I neglected to say my prayers, but had good health, good thoughts, and good humour, Thank God almighty." Byrd's diary tells us that on one occasion they "were so merry that Mr. Catesby sang." This may in part tell the tale of Catesby's seven years in Virginia and his lamentation of his lack of accomplishment: "I thought then so little of prosecuting a Design of the Nature of this Work, that in the Seven years I resided in that country (I am ashamed to own it) I chiefly gratified my Inclination in observing and admiring the various productions of those countries, "- - - only sending from thence some dried specimens of plants and some of the most specious of them in tubs of earth, at the request of some curious friends."

Upon Catesby's return to England, we see a different and transformed Catesby, no longer the carefree adventurer, but now a man on a life's mission, to render and complete a monumental task, a first complete, illustrated natural history of the New World.

Samuel Dale, famed botanist and apothecary, provided Catesby's introduction to England's premier botanist, William Sherard, and he lobbied several of his Royal Society friends to sponsor Catesby's second trip, this time to Charles Town. Col. Francis Nicholson, who was to depart for South Carolina in 1720 as its first Royal Governor, agreed to provide Catesby with a 20 lb. per year pension and necessary introductions. (Incidentally, Nicholson had been a Royal Governor of Virginia, supervised the transfer of the capitol from Jamestowne to Williamsburg, and was largely responsible for laying out the town of Williamsburg.) Catesby also secured other support, especially that of Sir Hans Sloane. Sloane had made a voyage to Jamaica in 1687, amassing a collection of some 800 plants, including cacao, and inventing milk-chocolate, which he used in a medicinal context; he was President of the Royal College of Physicians, was the first medical practitioner to receive a hereditary title, and would later become President of the Royal Society, succeeding Sir Isaac Newton. Too, he laid the foundation for the British Museum.

When Catesby arrived in Charles Town in 1722 for his four-year visit, regretting the unstructured and disorganized nature of his first venture, he quickly set out on carefully planned collecting trips. He would send botanical and animal specimens back to England, birds preserved by baking them in ovens and stuffing them with tobacco leaves and snakes placed in jars of rum, which were often pilfered by thirsty sailors on the voyage to England. In 1725, Catesby traveled to the Bahamas, staying with Governor George Phenney, and it was there on a sloop that he recorded the migration of rice birds or bobolinks, surmising that they were following their food supply, traveling from the rice fields of Cuba to those of the low country of Carolina.

Catesby returned to England in 1726, and he immediately set out on the twenty-year project of making The Natural History of Carolina, Florida and the Bahama Islands. Whenever possible, Catesby had painted from life, and he concentrated on his next choice of subjects, birds, which he saw as a natural extension of botany: "having oftenest relation to the plants on which they feed and frequent." Interestingly, plants and birds are the sole subjects of this first volume, but

the second volume included a variety of fauna and flora. In all, he painted 109 birds, 171 plants, 33 reptiles and amphibians, 46 fishes and 20 snakes, and 9 mammals, noting that North American mammals too closely resembled European ones. One can assume that he omitted numerous birds, notably the turkey, shorebirds and others, for similar reasons.

Since Catesby's primary interest was botany and sending plants back to his native England provided income for his stay in America, his decision to concentrate on birds for his first volume is likely no accident. Indeed, his goal was to present a spectacular view of the natural history treasures of the New World, and what better vehicle than colorful birds. Aaron Bauer (2015) succinctly reveals the answer to the question of why most of the images and text devoted to non-avian species are found in the second volume. "Undoubtedly, Catesby's decision to concentrate on birds over other animals in the first volume reflected his own interests and competency. This was probably also a calculated business decision as Catesby needed to generate income through subscriptions and including the plates of birds, the most popular subjects of study and general interest at the time, in the first parts to be issued would have best served his aim." In a sense then, the popular view that Catesby was primarily an ornithologist arose from the economic expediency of producing plates of birds for consumption in England, and his overall contribution to the science of ornithology is not really much advanced over that of his predecessor John Lawson. Indeed, Lawson (1709) had recorded 129 species, exceeding Catesby's list by 20. To put it more in perspective the number of Catesby's North American birds could easily be observed in one day in and around the Charlestown area. Thus, Catesby's (1748) statement of his natural history: " . . . both volumes, . . . containing in all 113 . . . all the land birds I have ever seen, or could discover, in that part of North America included between the 30th and 45th degrees of latitude." would appear to reveal his desire to push his Natural History for commercial subscriptions. It seems likely that Catesby was far too busy collecting plants for English patrons

Figure 4 - Examples of Catesby's pioneering art combining plant and animal on the same plate. Here the White Curlew (Ibis), (I,82), with the Golden Club, and the Parrot of Carolina (I,22), with Bald Cypress, illustrate the association by combining a herbarium sheet with the bird.

than to spend exhaustive time searching for birds, which he most likely encountered while in search of plant material. But this essay concentrates on Catesby's birds.

Catesby's birds can perhaps artificially and for discussion, be divided into categories, which show somewhat of a progression towards the Audubonian era of natural history art. There are plates that combine bird and plant by placing the bird in front of a herbarium sheet, as illustrated in Figure 4, showing the White Ibis with the golden club, and the Carolina Parakeet with the bald cypress. There are those that show behavioral activity, such as the Ruddy Turnstone, attempting to flip a stone (Fig. 5); yet Catesby greatly exaggerated this behavior: "In a voyage to America in the year 1722 . . . 40 leagues off the coast of Florida, the bird . . . flew on board us, and was taken. It was very active in turning up stones, which we put into its cage . . . it would . . . with great dexterity and quickness turn over stones of above three pounds weight." In reality turnstones are likely incapable of turning over any stone greater than several inches, and typically walk along the beach flipping small stones, shells and other objects in their search of food items.

Figure 5 - Catesby's bird art and text includes examples of exaggeration. Catesby remarked of a Ruddy Turnstone (I,72), that landed on a ship at sea, was placed in a cage and, "it would . . . with great dexterity and quickness turn over stones of above three pounds weight." In reality, they only flip small stones, shells, etc. in search of food.

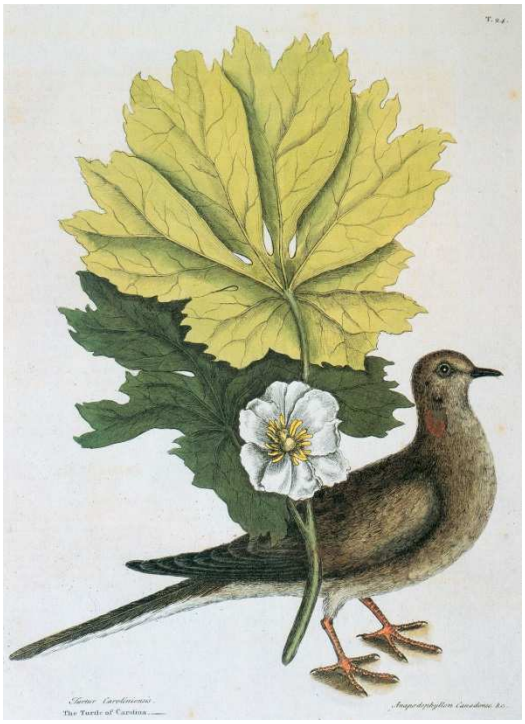


Figure 6 - Catesby's bird art includes highly improbable associations of bird and plant, illustrated by the Turtle Dove of Carolina (Mourning Dove), (I,24), and Mayflower, a moist forest floor plant that grows under tall trees providing partial or full shade, but was also used for medicinal purposes.

Figure 6 illustrates one of Catesby's birds with a highly improbable associations of bird and plant, illustrated by the Turtle Dove of Carolina (Mourning Dove) and Mayflower, a moist forest floor plant that grows in shade under tall trees. Note here again, that May-apple (Mayflower) is another medicinal plant, as Catesby notes, "The root is said to be an excellent emetic, and is used

as such in Carolina which has given it there the name of Ipecacuana, the stringy roots of which it resembles." Another example is the Eastern Bluebird on a stump near the ground with the sarsaparilla vine (*Smilax pumila*), a low-lying perennial of swamp forests and wooded coves

Some of the art reflects examples of associations of plant and animal illustrating Indian lore and myth, perhaps combined with a bit of humor. As for humor, the Yellow-rumped Warbler (I,58) shows the bird hanging from a thread (spider's web thread) from the rosebud orchid, an unlikely association since the plant blooms in May and June when Yellow-rumps would be in Canada and the northeastern US. Figure 3 shows the American Robin lying dead on a stump of the snakeroot (*Aristolochia serpentaria*), a plant that during colonial times was prized as an antidote for snake

bite, although it is hard to imagine just how much good it did. Another such association is Catesby's Whip-poor-will on the forest floor with ginseng, which likely reflects mystical Indian beliefs: ("The Indians say these birds were never known till a great massacre was made of their countryfolks by the English and that they are the souls of the departed spirits of the massacred Indians. Abundance of people here look upon them as birds of ill omen, and are very melancholy if one of them heppens to light upon their house, or near their door, and set up his cry . . . for they verily believe one of the family will die very soon after."

Likewise ginseng was highly prized by the Chinese as a panacea for various ailments, including weaknesses and fatigues, either of body or mind. Chinese thought it, "strengthens the vital spirits, and is good against dizziness of the head and dimness of sight, and that it prolongs life to extreme old age" (see Feduccia 1985). The generic name *Panax* (Greek Panakos, a panacea), is in reference to the miraculous nature ascribed to it by the Chinese, who considered it a remedy for many diseases. The Chinese word ginseng means wonder of the world. The Indians had similar beliefs.

Catesby's bird plates, not unexpectedly, also illustrated confusion among early naturalists concerning the true identification of some species, particularly the plate of the Chuck-will's-widow, which combined traits additional species including the Common Nighthawk and Whip-poor-will (Fig. 7). The same is true of Catesby's White Heron (Plate 77), which is an immature Little Blue Heron (Plate 76).

Figure 7 - Some of the plates show confusion on identification. The plate below is the Goatsucker of Carolina, presumably the Chuck-will's-widow (I,8), but it is a strange combination of that species, combined with the Whip-poor-will and the Common Nighthawk.

In February 1733 Mark Catesby was elected a Fellow of the Royal Society of London. Catesby's work became among the most influential of the 18th century, and Royal Society Secretary Cromwell Mortimer called Natural History, "the most magnificent work I know since

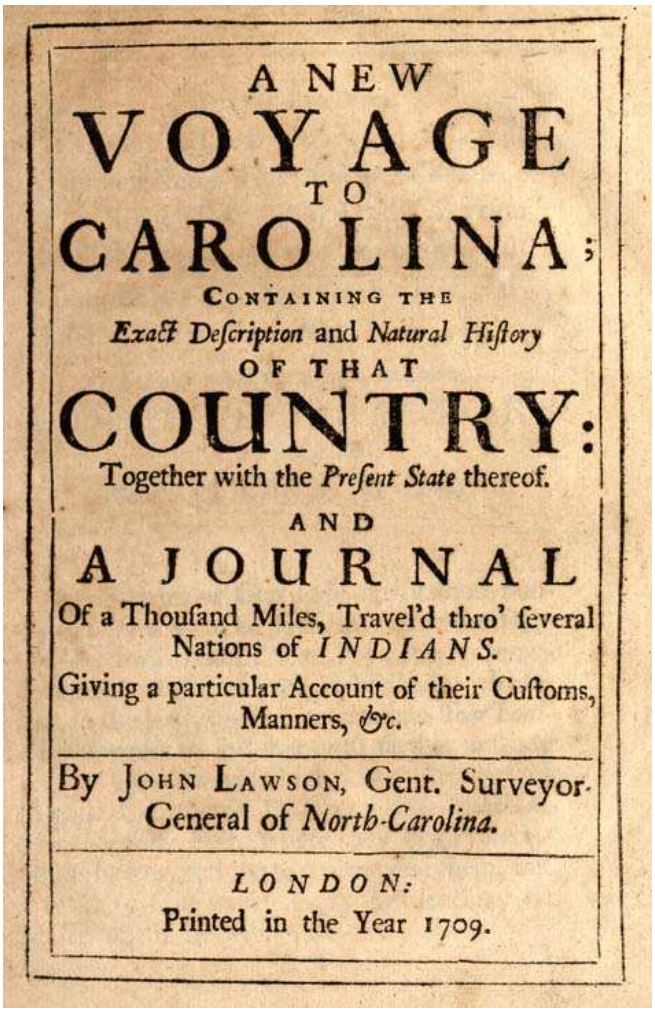
the Art of printing has been discovered." Catesby was the first to fit plant and animal on the same plate in a meaningful and lifelike ecological setting, the first to note the impact of man on environmental degradation of the pristine environment of the New World, the first to record bird migration, the first to discover the phenomenon of the increase of animal species in southern latitudes, known now as tropical diversity, and he dispelled many of the myths of the animal world. Catesby was the first person to paint a carnivorous plant, the pitcher plant, first to report a vertebrate fossil from North America, a mastodon tooth, first to recognize that the coastal plain was geologically under the sea, and he recognized that the American Indians were of Asiatic derivation. Above all, Mark Catesby for the first time displayed to the Old World in a colorful and vivid form the biota of the New World. His work was the most lavish printing production of the 18th century, was among its most influential, and was widely acclaimed across Europe and America.

But those who paved the way for Catesby accounted to a large extent for his success. Most meaningful of the earliest was John White. Over four hundred years ago, and more than a hundred years before Catesby, this Elizabethan gentleman and artist was making the first drawings of the New World. It was White who was the first person to give England a vivid view of the American fauna and especially its native inhabitants, through Harriot's 1590 book on Virginia, featuring the famous De Bry engravings. John White made four voyages to the New World, the first in 1585, to the coast of North Carolina, and produced an extraordinary series of watercolors documenting the culture of the Algonquian Indians and local biota, which recorded the only visual record of England's first attempt at a New World settlement. In 1709, Sir Hans Sloane discovered that one of White's descendants had a volume containing 113 White drawings (curated at the British Museum), and Sloane had a copy made which he subsequently showed to Catesby, who was quick to use them to supplement his own work, directly plagiarizing seven with no acknowledgement, except for a mention of Sir Walter Raleigh and the Sloane volume. The Cat Fish (Fig. 8), a bit humorous, certainly unrecognizable as to species, was cited by Linnaeus in the tenth edition of Systema Naturae in 1758 and was actually used for the type of a valid fish species! Identification of the fish is not possible. Other plates copied from John White included the Andros Island Ground Iguana (*Cyclura cychlura*), Catesby's Guana, is a copy from White, but placed in a pond-apple (*Annona glabra*) in an attractive pose (Fig. 8). There was a total of seven images copied from White's work, including notably the land crab and gar, the latter being used along with the Cat Fish by Linnaeus for types of valid species; however, at least the gar was identifiable. Most of the copied plates are identifiable by some peculiarity of the White plate, for example, the remora's head is tilted to show the strange top; and Catesby's land crab (fiddler crab) has the enlarged claw reversed from that of White.

The next truly significant explorer/naturalist was John Lawson, who arrived in 1700 to the nine-acre metropolis of Charles Town, and who ultimately provided the definitive framework for Catesby's *Natural History*. Born in 1674, the son of Yorkshire landholder, Dr. John Lawson, the adventurous young Lawson set sail for the New World, and later the same year was hired by the Lords Proprietors to reconnoiter the backcountry. Following his remarkable 59-day, 550- mile trek (1700-1701) through the backcountry of what is now South and North Carolina (from Charleston in a north-western "horseshoe" on east to the Pamlico Sound), he kept an extensive journal which would become the most important document of the Proprietary Period and was published in 1709 as A New Voyage to Carolina (frontispiece, Fig. 8), subsequently published in

three English and two German editions between 1709 and 1722. It was widely read and widely plagiarized. He was later appointed as Surveyor General of North Caronia, was co-founder of the first two towns in North Carolina, Bath and New Bern, and died an untimely death at the hands of the Tuscarora Indians, in the Tuscarora War of 1711, on an exploratory trip up the Neuse River with Baron Christopher von Graffenreid, by a method Lawson himself described in his book, a method by which the victim was impaled with splinters of resin-rich pine, producing a human porcupine, then lighting these, as Lawson notes, “which burn like human torches; and in this manner, they make him dance round a great Fire, every one buffeting and deriding him, till he expires.” Catesby was well aware of Lawson, and noted that, “I cannot but lament the hard fate of this inquisitive Traveler.” Lawson provided broad shoulders on which Catesby could stand, as Lawson had been in negotiations with James Petiver in 1710 to undertake a natural history of America. Lawson’s untimely death paved the way for Natural History, and interestingly both Catesby and William Byrd II would later make extensive use of Lawson’s book. As for plagiarism, Catesby was not the first to use Lawson's text, the two most famous (or infamous) were: John Brickell's The Natural History of North Carolina, which is nearly an exact transcript; and William Byrd's Natural History of Virginia, or the Newly Discovered Eden, which was originally published in German By Samuel Jenner in 1737---but, as Hugh Lefler noted in 1967: "The real author of the Natural History of Virginia was Lawson, certainly not William Byrd." Likewise, as we know a good portion of Catesby's section on Indians was lifted directly, with slight modification, from Lawson, although he acknowledges Lawson.

It is unlikely that Catesby could have had enough contact with Indians during his stays in America to write extensively on the native people as he does in his book. By the time Catesby arrived in 1712 to Jamestown Harbor, most of the Indians had been devastated by the advent of Europeans, by war, but mainly by epidemic diseases. As evidence of the demise of the native Americans in 1701 in his voyage after traveling across the heart of "Carolina" John Lawson noted that there was not the "sixth Savage living within 200 miles of our settlements as there were fifty years ago" . . . and that: “coastal tribes were "very much decreas'd . . . And all other nations of Indians are observed to partake of the same fate, where the Europeans come." (Lefler 1967). Most of Lawson’s contact with Indians in their more or less original state was with the coastal Tuscaroras, from whom he eventually met his demise on a trip along the Neuse River near New Bern, NC. Catesby visited a remnant Pamunkey Indian village in Virginia, and had some minor Indian contact in South Carolina with the Yamassee tribe, but even these natives were far beyond their original natural state and culture. Warfare, epidemics and slavery had decimated the Indians along the coast and coastal plains of Virginia and North Carolina, and little remained of their original customs. The Contact Period was one of devastating and sweeping change among the Indians from Virginia to South Carolina. The Cherokee were more isolated to the west and were only later affected by Europeans (forcibly removed in 1838). So, only a half century later this western tribe would undergo the same devastation and fate of their Piedmont cousins. Close of the bloody Tuscarora wars occurred about 1713. Following that there were only a few hundred Tuscarora remaining, largely women and children living in scattered small groups. Sadly, by the time Catesby arrived in 1712 to Jamestown Harbor, most



A NEW
VOYAGE
TO
CAROLINA;
CONTAINING THE
Exact Deſcription and *Natural Hiſtory*
OF THAT
COUNTRY:
Together with the *Preſent State* thereof.
AND
A JOURNAL
Of a Thouſand Miles, Travel'd thro' ſeveral
Nations of *INDIANS.*
Giving a particular Account of their Cuſtoms,
Manners, *&c.*

By JOHN LAWSON, Gent. Surveyor-
General of *North-Carolina.*

LONDON:
Printed in the Year 1709.

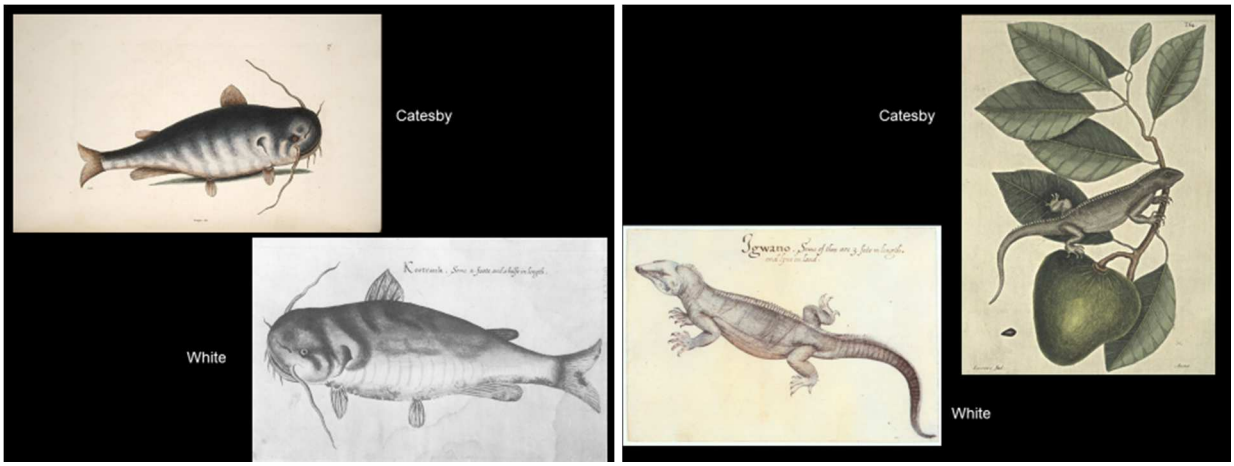


Figure 8 - Catesby plagiarized extensively from John Lawson's text, frontispiece below (especially in his section on Indians), but also John White's drawings (below) which were shown to him by Sir Hans Sloane, then Superintendent of the British Museum. Some, such as illustrated here, were copied by Catesby and subsequently used in his Natural History. The Cat Fish (II, 23), is not identifiable, but was used by Linneaus for a formal taxonomic designation. The Andros Island Ground Iguana (*Cyclura cychlura*), (II, 64). Catesby's Guana, is a copy from White, but placed in a Pond-apple (*Annona glabra*). There are seven plates copied from the John White drawings.

of the Indians had been devastated by the advent of Europeans, by war, but mainly by epidemic diseases.

Catesby took great liberty with the Lawson text. Catesby readily acknowledges that he did not like to write, and he does credit Lawson with respect to the section on Indians, but there is much more. Much of this is to point out that the actual text of Catesby may refer largely to the Indians at a somewhat earlier period, and we should not make too much of Catesby's use of Lawson, because such was not considered a major problem in the eighteenth century. Too, Catesby clearly states that he is interested in showing the reader by art and not the written word: "The illuminating natural history is so particularly essential to the perfect understanding of it, that I may aver a clearer idea may be conceived from the figures of animals and plants in their proper colors, than from the most exact description . . .wherefore I have been less prolix in the description, judging it unnecessary to tire the reader. . . ."

Aside from the section on Indians there are other places where Catesby clearly plagiarized Lawson, three examples being:

Lawson: "The devil-fish lies at some of our inlets, and as near as I can describe him, is shaped like a scare, or stingray; only he has on his head a pair of very thick strong horns, and is of a monstrous size, and strength; for this fish has been known to weigh a sloop's anchor, and run with the vessel a league or two, and bring her back, against tide, to almost the same place."

Catesby: "It is a large fish, and of great strength, as will appear from the following circumstance. A sloop of 80 tons lying at anchor in the harbor of Charles-Town, was on a sudden observed to move and scud away at a great rate; this being in view of hundreds of spectators, and it being known that nobody was on board, it caused no small consternation. At length it appeared to be of these fish, which had entangled its horns with the cable, and carried the sloop a course of some leagues before it could disentangle itself from it, which at length it did, and left the sloop at anchor again, not far from the place he moved it from."

Lawson: "The Indians ground their wars on enmity, not on interest, as the Europeans do; for the loss of the meanest person in the nation, they will go to war and lay all at stake, and prosecute their design to the utmost; till the nation they were injur'd by, be wholly destroy'd."

Catesby: "Indians ground their war on enmity not interest, as Europeans generally do; for the loss of the meanest person of the nation they will go to war, and lay all at stake, and prosecute their design to the utmost, till the nation they were injured by being wholly destroyed."

Lawson: "Most of the savages are much addicted to drunkenness, a vice they never were acquainted with till the Christians came amongst them."

Catesby: “The savages are much addicted to drunkenness, a vice they never were acquainted with till the Christians came amongst them.”

Taken in all Catesby’s main mission in America was largely botanical and only later on his second voyage did he concentrate on his illustrations to produce a natural history volume. While plagiarism of Lawson and White, and other problems with accuracy make it difficult to have much confidence in some of the natural history, his overall contribution was Herculean. Catesby’s mission was to showcase the natural world of the Americas to the Old World.

Indeed, Catesby did just that, producing the finest art of its day, combining animals and plants for the first time in a meaningful fashion. Catesby notes, “I always did them while fresh and just gathered, and . . . I have adapted the birds to those plants on which they fed, or have any relation to.” Most are nicely fitted to flora, sometimes, as with the White Ibis and golden club, and the Carolina Parrot with the bald cypress, as though the bird was fitted to a herbarium sheet; others, like the Bluejay and smilax are extremely lifelike, approaching the art of the Audubonian era. Others show his sense of humor, associating the dead robin with the snake root. There are some that had no association, and Catesby admits, “for some kinds I saw not plenty of . . . .” The overall Natural History is a masterpiece of its age, and is a perfect prelude to the Audubonian era as shown by Catesby’s Bluejay (Fig. 9).

The animal activist and ABC TV naturalist and commentator Roger Caras (in a blurb for my book, Feduccia, 1985) brilliantly captivated the rebirth of interest in Catesby: “Even before Audubon, there was Mark Catesby. Catesby is a national treasure who recorded the splendors of a newly explored continent. Making him accessible to a broad audience is a gesture of patriotism and scholarship both. To acknowledge Catesby is to honor conservation, the environment, fine art, historical scholarship, and the spirit of a pioneer.” Few men have left a prouder monument than Catesby did with his Natural History!

On April 16, 1747, Peter Collinson in a letter to Linnaeus, wrote: “Catesby’s noble work is finished.”

Figure 9 - Some of Catesby’s drawings show exceptional artistic ability, approaching as shown below, the Audubonian era. Below, the Bluejay (I,15), Catesby’s with Smilax, and Audubon’s plate with Trumpet Creeper.

NOTES

This manuscript derived in part from the keynote address for the symposium "Mark Catesby's America" 9 June 2008 at Meyer Auditorium, Freer Gallery of Art, Smithsonian Institution. Sponsored by the Smithsonian Institution Libraries. The Introduction was adapted in part from Feduccia (1985).

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Ornate Hawk Eagle (*Spizaetus ornatus*) graphite drawing

Craig Farquhar

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Artist's Statement - At the 2002 North American Ornithological Conference (New Orleans, Louisiana), an art exhibit, entitled "THE AUDUBON LEGACY: THE ORNITHOLOGIST AS ARTIST" was organized by the amazing, internationally acclaimed artists, John O'Neill and Doug Pratt. Ornithologists who also draw or paint were welcomed to enter their works so I'd submitted some original graphite drawings, and one of those was of an Ornate Hawk-Eagle (*Spizaetus ornatus*) I'd drawn in 1999. Keith was sitting outside the exhibit hall as I was preparing to hang my drawings, we reminisced and talked at length about birds and art. I'd been fortunate enough to have Keith as my doctoral advisor as I pursued my keen interest in raptors, specifically White-tailed Hawks. But he was unaware that I'd also developed an interest in illustration, as I'd only attained the skills after my tenure at A&M. He spied my hawk-eagle portrait, studied it a good while and gave me many nice compliments. After I'd hung the drawings he pulled me aside and, to my complete shock, whispered he'd be willing to give me $1,000 in cash for the hawk-eagle illustration right then and there! Flattered and humbled, and despite the ominous warning from the heavens via Hurricane Isidore which skirted its eye over the city during the conference (hotel staff abandoned post but left us nice notes advising us to be sure to fill our bath tubs with water that we would want on hand to drink over the next few days until rescue arrived by helicopter), I nonetheless politely declined the offer. It was the first raptor portrait I'd done and I was very fond of it, but thank you.

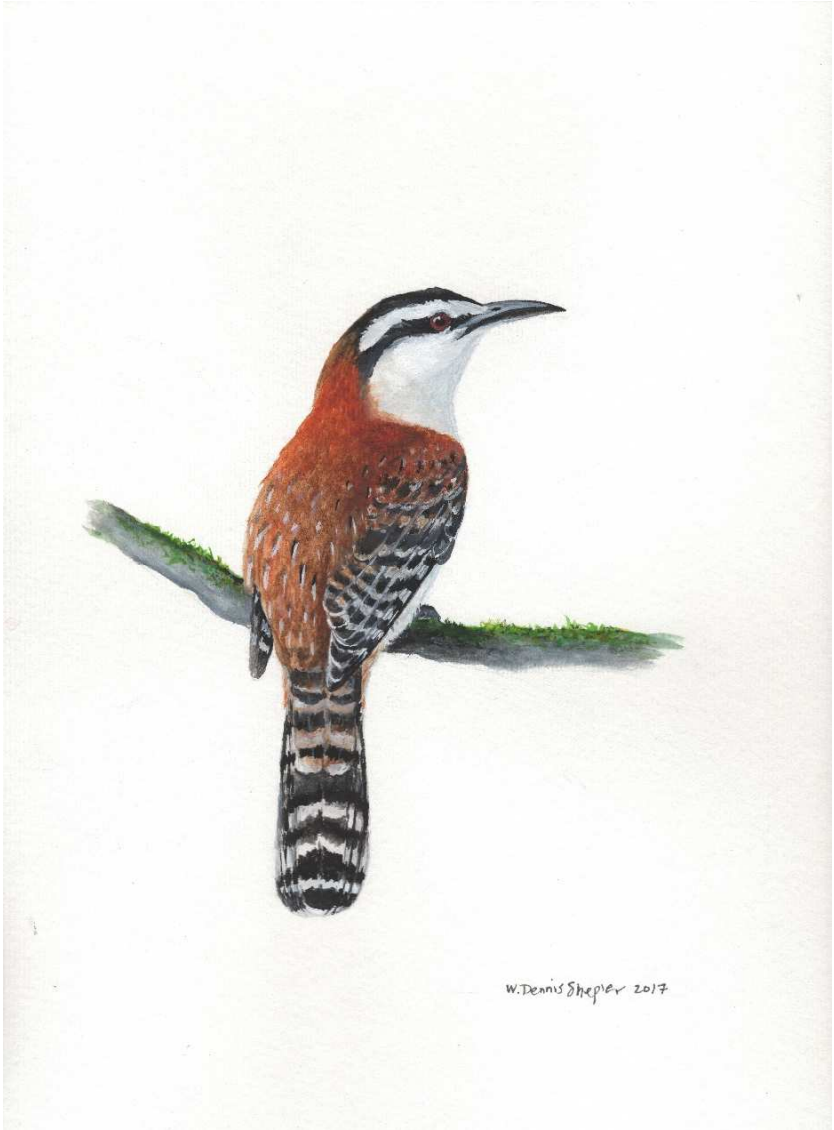
In retrospect, however, I should have listened to Isidore and made that sale to Keith because that original Ornate Hawk-Eagle portrait, sadly, was later incinerated in a fire that destroyed my family's home in 2009. I'd had archival quality prints made of that drawing, too, but, dreadfully, they were similarly vaporized in the blaze. OK, devastated but trying to keep my cool, I promptly turned to the printer but, in the continuing tragedy, he'd inadvertently destroyed the original plates! Alas, in the end, all was not lost since I'd thankfully made a high resolution scan of the original which I've reproduced especially for this warm appreciation of Keith's lasting legacy. I owe Keith a large debt of gratitude, for which my contribution here could only represent a very small portion.

Rufous-naped Wren (*Campylorhynchus rufinucha*) watercolor painting

W. Dennis Shepler

12987 Trail Hollow, Houston, TX 77079 - dawgler@gmail.com

Artist's Statement - This watercolor image on paper is based on a field sketch that I made in Costa Rica in 1996. I had emailed an image of the sketch to Dr. Keith Arnold and he commented that he liked it. For many years, I had wanted to use the sketch as the basis for a painting. This was the first species of wren that I observed in Costa Rica and, on subsequent trips to the Guanacaste region, I was able to observe this large, showy species on numerous occasions. Knowing of his graduate work on *Thryothorus* wrens, I hope that this image will convey to Keith the special feelings we share regarding the wonderful Troglodytids of Costa Rica and the special admiration I have for Keith as an educator and a friend.



Study sketches of owls (Strigidae) of North America

Terry Maxwell

Angelo State Natural History Collection, Dept. of Biology,
Angelo State University, San Angelo, Tx 76909 – Deceased

Artist's Statement - I did not know before that Dr. Arnold was particularly fond of owls, but I am glad to find that so. We then share an affinity with this curious clade of nocturnal predators. What is it about owls that pulls him and I and so many others to them? It would be too easy to attribute their popularity in total to those expressive eyes and almost human facial countenances. It's more than that.

For me, it's their mysteriousness. You have to work to see any owl well; often you must join them in the dark of night to experience the essence of owl. I had a group of students in the Davis Mountains of far West Texas one fall. We were led up a canyon, hiking and boulder hopping for hours, before getting the briefest of glimpses of a Mexican Spotted Owl. I expected no less effort.

But for the artist, it's back to those eyes. You have no hope of illustrating the essence of owl without getting right the eyes. Dr. Arnold, these owls and their eyes are for you. Enjoy.

(**Editor's Note:** Quite shocking to all of us, Terry passed away on 25 April 2017. He was the first to reply to the invite to contribute to this Festschrift, and was very excited about same. We were in touch less than one week prior regarding the final touches for his contribution. Dr. Arnold wrote one of the nicest encomia for Terry the following day. In a most unusual twist of fates, we offer it here – the Festschrift honoree's encomia for one of the contributors:

A sad day, indeed and quite a shock. Terry was not only a former student (both B.S. and Ph.D.), but also a close and long-time friend. Bev and I coveted our friendship with Terry and Ann for many years.

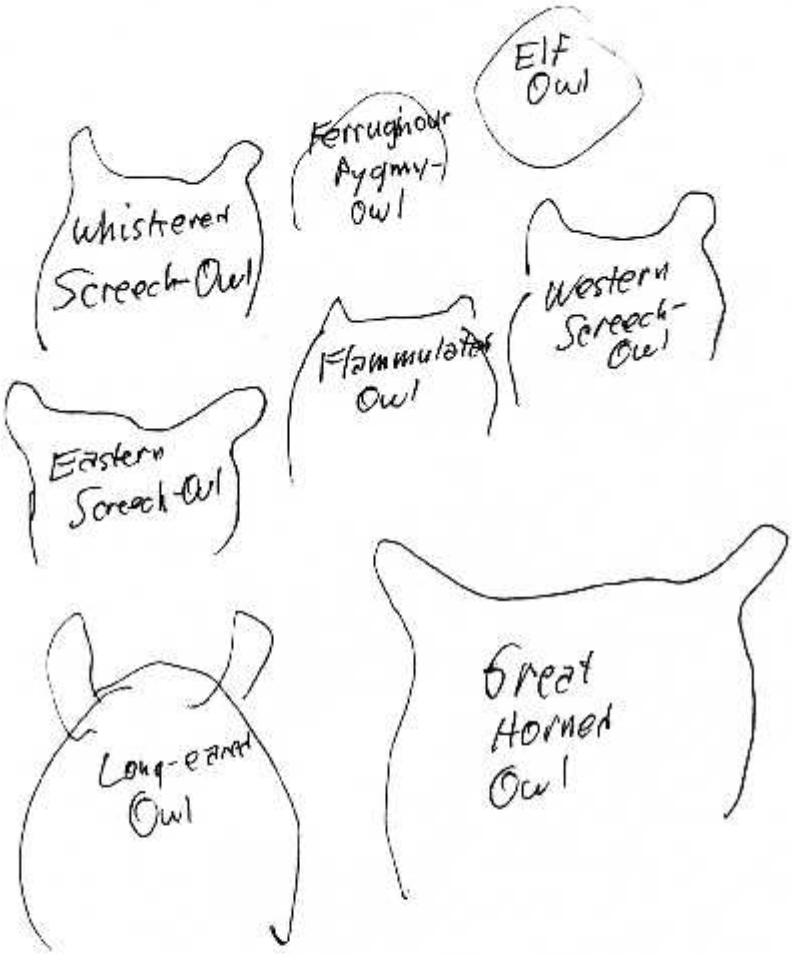
I had not been at A&M for even a week in 1966 when Terry walked into my office and introduced himself to this new Assistant professor. The two of us spent a number of days birding together in the next two years. After Terry graduated from A&M, he had a stint in the Air Force before returning to San Angelo, where he earned his M.S. at Angelo State University. Terry then returned to A&M to work on his Ph.D. under my direction. Of course, his dissertation topic dealt with the birds of his beloved Concho rover valley.

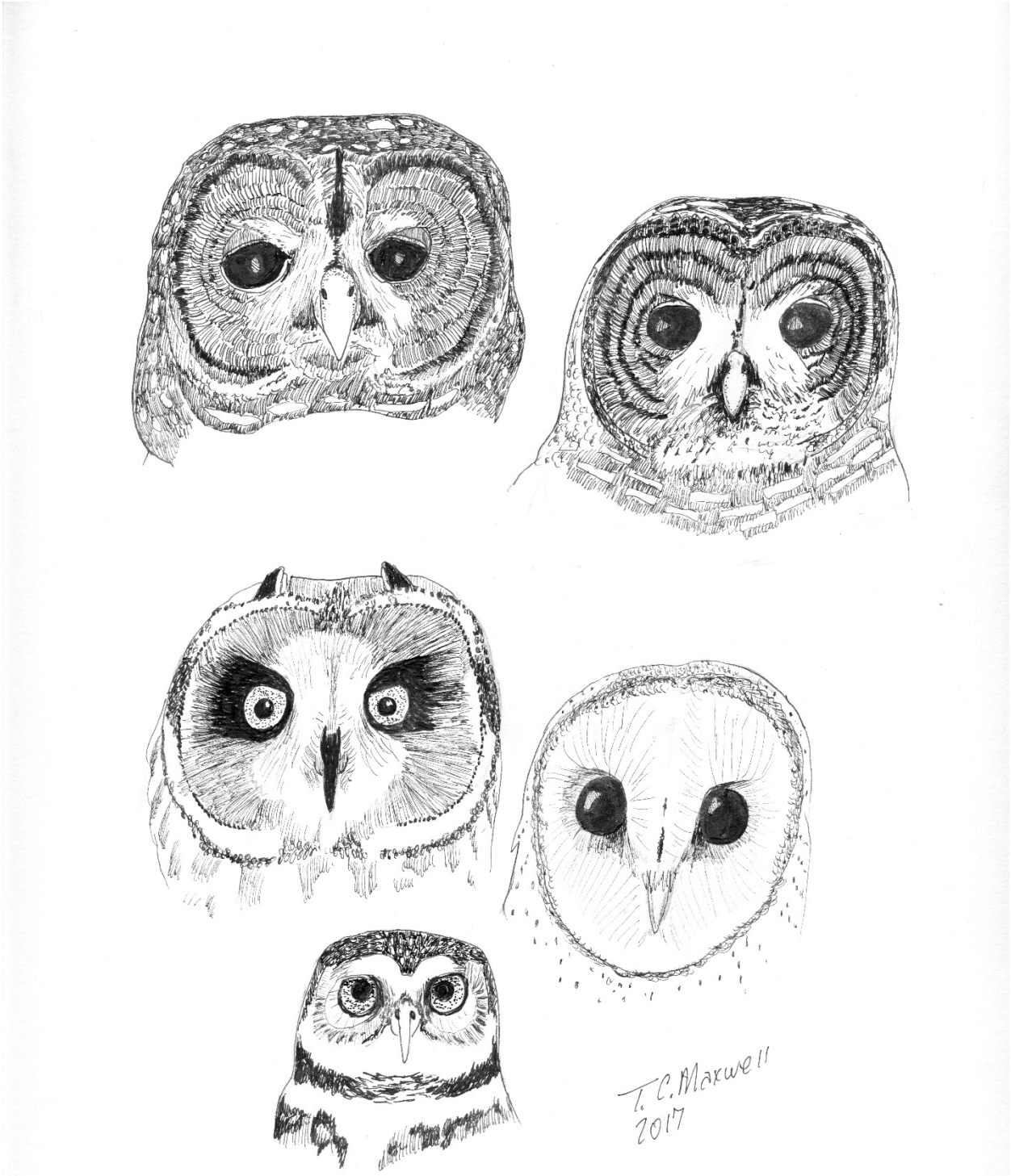
Terry was an excellent artist, with most of his work as pen-and-ink sketches. Bev and I treasure the three sketches that hang in our home: the gray fox from his book on the vertebrates of the Concho river valley and two from his most recent book on his life as a naturalist - the cover sketch of a bat on his head [my favorite] and the woodpecker sketch.

I think the term "naturalist" best describes Terry's role in the scientific community - it is not achieved by many in our current world of specialization.

- Keith A. Arnold


T. C. Maxwell
2017


Elf Owl
Ferruginous Pygmy-Owl
Whistered Screech-Owl
Western Screech-Owl
Flammulated Owl
Eastern Screech-Owl
Great Horned Owl
Long-eared Owl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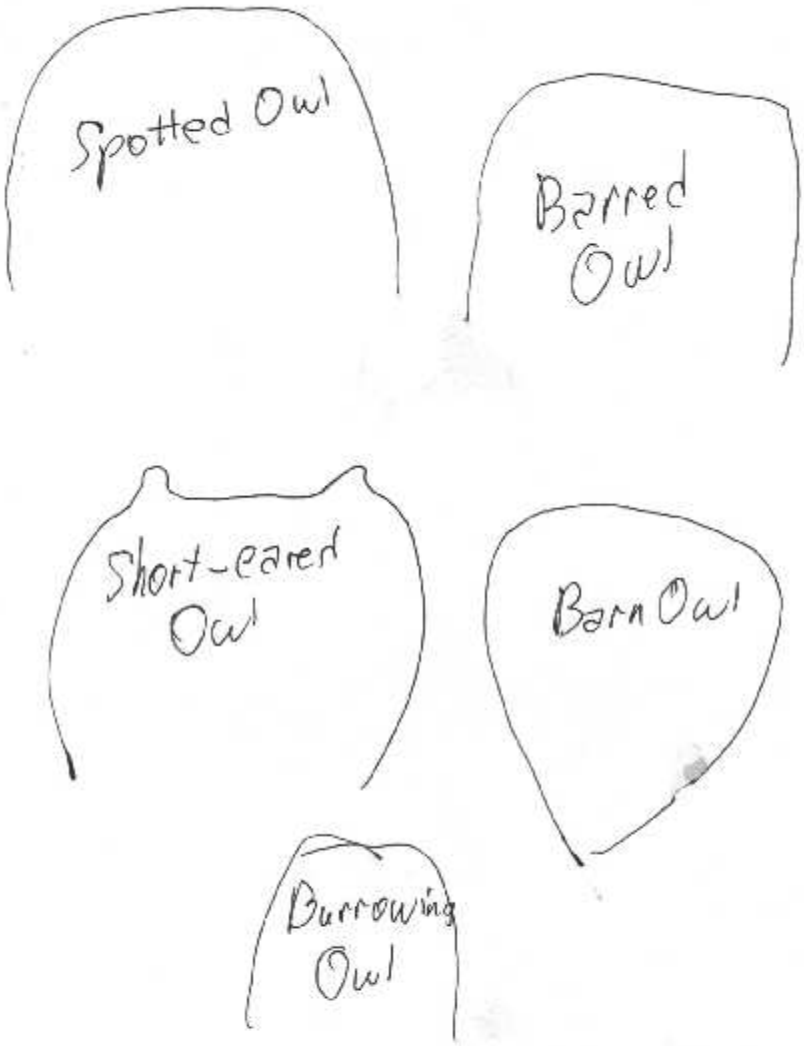
2017


Spotted Owl
Barred Owl
Short-eared Owl
Barn Owl
Burrowing Owl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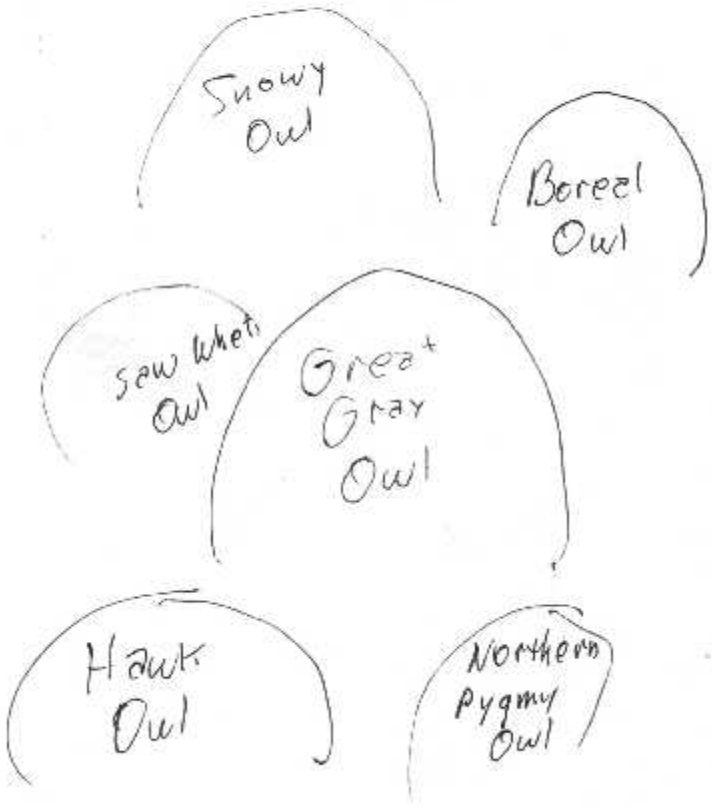
2017


Snowy Owl
Boreal Owl
saw whet Owl
Great Gray Owl
Hawk Owl
Northern Pygmy Owl

Arnold at Hunter's Point, Lake Conroe in 1978 (Photo by Nick Garza).

ENCOMIA

The first time I met Dr. Arnold…

(**Note:** This is a modified version of a speech delivered at Dr. Anold's retirement party in 2005)

My first knowledge of the legendary Dr. Keith Arnold was around 25 years ago (early 90s), when I was working towards a Master's thesis at Texas Tech University. I had some friends write up a note in the Texas Journal of Science, reporting what they thought was an unusual record of Elf Owl for West Texas. The note later received a scathing rebuttal by the leading Ornithologist in Texas, Dr. Keith Arnold. A couple of years later I experienced a similar fate when I tried publishing a note on the occurrence of a Collared Forest-Falcon in Texas before submitting the record to the Texas Rare Bird Committee (TRBC), which Dr. Arnold initiated and Chaired, largely to keep Bozos like me honest. It was these early experiences that made me in awe of this beastly monster of a man, Dr. Keith Arnold, and I then realized he really was where the buck stopped with Texas birds.

A year later, while collecting data on birds at the Natural Science Museum at LSU, I wandered over to a far wall in the bird collection range containing a large photo gallery. I was indeed humbled by the photo gallery of students of the late George Lowery. These included the likes of Joel Cracraft, Fran James, Burt Monroe, Doug Pratt, Steve Russell, Edwin Willis, and others, including this god of Texas Ornithology, Keith Arnold. It was hard to believe many of these individuals pictured were the same people! For example, the picture of one young kid (whom I shall refer to simply as "J", lest I lose my kneecaps) reminiscent of the banjo player in "Deliverance", later turned out to be one of the fiercest and dominating Ornithologists in the field (he once eloquently reminded me that phylogenetically I was related to an amoeba). When I later learned that this commanding force of a figure, Dr. Keith Arnold, nearly threw this young fellow grad student, J, off a cliff in Costa Rica during an extended field expedition, I said to myself, "This Arnold guy's a HERO! I have to meet him…."

It was shortly after this experience in 1995 that I stumbled up the stairs to Nagle Hall to meet Dr. Keith Arnold to discuss possibilities for my Ph.D. work. I was a little intimidated huffing and puffing my way to Dr. Arnold's office, wondering if he would send me packing, or throw me out the window! What amazed me most was how kind this man was, taking time out of his crazy schedule to meet me and provide his good graces. What amazed me even more was how he did not believe in the utility of standard filing cabinets, but rather kept all paperwork in tall vertical columns. He would run an index finger up and down the stack of papers piled at least two feet high until he found what he was looking for, then somehow miraculously was able to pull the form he needed out from the bottom of a stack! After Arnold yanked out the needed form, the stack swayed back and forth a little, but finally settled at rest in an upright position. I knew then that this was no ordinary man I was dealing with!

As I got to know Dr. A (as his students call him), I realized this man was not a monster, fierce, hyper-territorial, or any of the things my imagination led me to believe before meeting him. What he was, in fact, was kind and patient, humble and encouraging, and probably more supportive than any authority figure I've ever worked with in my life.

Dr. A gave me free reign on my dissertation topic, reeling me in a little if I strayed too far off course. I should add that many folks didn't understand what I wanted to focus on for my dissertation, let alone why I wanted to study that topic, but it all turned out ok in the end. He showed concern once when I strayed past my typical study region in the Peruvian Amazon into Colombia, but was happy that I came back in one piece.

Back then I had long and scary hair that I kept in a ponytail most of the time, for the majority of my graduate career at A&M, but I decided to cut it off during my last year, as I wanted to impress my graduate committee and would soon begin the job hunt. I didn't bother telling anyone in advance to prepare them; I just showed up at the Texas Cooperative Wildlife Collection (TCWC) with short hair one day. When Dr. A saw me he had a hard time believing his eyes. After inquiring why I cut my hair off and me providing my standard answer, he patted me on the shoulder and consoled, "poor thing… it'll grow back if you change your mind".

Dr. A supported any project I wanted to do as long as it dealt with birds! I was working on biogeography of a group of nocturnal birds called Potoos when I first arrive at A&M. Dr. A helped me borrow the needed specimens from the museums in the U.S. holding Potoo specimens I needed for comparison. One of the first projects I ever worked on with Dr. A was studying subspecific taxonomy of Texas owls. This was the first time I ever really dealt with alpha taxonomy, so Dr. A was exceedingly patient in showing me what to look for. Part of the results of that work is now a publication we co-authored. When I touch base with Dr. A these days he's just as patient with me today as he was then, taking the time needed to make sure I understand what I'm doing. Indeed, I'll always remain indebted to him….

Perhaps the single quality that I value the most in Dr. A is how important family and community are to him. I know a lot of brilliant scientists, but I don't know as many that are as dedicated to their profession as they are to spending quality time with their families, while finding time to do what is important to them (e.g., playing hard, active in their community, etc). Dr A was a phenomenal role model in this area; I was able to garner his interest when I described my first birds (Philippine Owls, the publication dedicated in his honor), but I *really* got his attention when I became engaged, married, had kids, etc. When I met Dr. Keith Arnold for the first time - I knew that this was someone I could learn a LOT from (and not necessarily only about birds…).

- Daniel M. Brooks

Brooks audio-recording in the Peruvian Amazon during dissertation research in 1996. (Photo by Jeanne Copenhaver).

Doc Arnold in field and class:
an admiring student's recollections of a near-sighted birdologist

Let's get some facts on the table, right up front. I was a wise-ass when I arrived at Texas A&M in September of 1973 to begin my junior year. And most folks, including my patient wife, will tell you that time hasn't sanded off much of my wise-ass edges. So, I transferred to A&M with some swagger, abundant ego and supreme confidence in my birding skills and knowledge, all of which, of course, were borne of youthful ignorance. I'd come from Oregon State in Corvallis, where Dr. Bob Jarvis had been mentoring me a bit. It was he who suggested I consider A&M and its Wildlife program when I told him that, for financial reasons, I had to duck out of OSU and look for suitable schooling in Texas.

One of the first academic figures I encountered when I checked into Nagle Hall at my new A&M home was a vaguely intimidating fellow with thick horn-rims, slick-backed dark hair that was graying at the temples, eyebrows that seemed perpetually arched in focused inquiry and a salt-and-pepper goatee. Of course, far from being off-putting, Doc Arnold was to become not only my Master's committee chair and advisor, but my mentor and most reliable inspiration for scientific growth and guidance.

Doc was one of many highly published, academically gifted and professionally lauded professors who inhabited Nagle Hall when I landed in College Station. I did not realize until much later in life how lucky I'd been to have rubbed academic elbows with him and them. In addition to Doc and his ornithological prowess, there was mammalogist Dave Schmidly, herpetologist Jim Dixon, turkey and habitat specialist Sam Beasom, ecologist Nova Silvy, physiological ecologist Brian Cain, ethologist Fritz Walther, the newly-hired avian ecologist Doug Slack, and department head Jim Teer, the king of the white-tail deer, among many others. And presiding over all of that academic horsepower was W.B. Davis, the emeritus master of all taxa, who took to calling me *Yosemite Sam* for the robust flowing mustache that I sported in those days.

Fancying myself a budding ornithologist and avian ecologist, I latched on to Doc as an undergrad in September 1973, and held on all the way through completion of my MS in August 1978. I volunteered and assisted in his undergrad and graduate-level ornithology classes. I jumped in on ad-hoc field trips and birding expeditions with him for extended weekends and between semesters. I spent extra time in the lab to learn his techniques for putting up study skins. And I thumbed cowbirds at the traps he ran out by the Poultry Science barns (white leghorns, anyone?). Though time has dimmed some of the details, I have a few recollections that may be worth recounting, purely, of course, in admiring recognition of Doc and his scholarly contributions to Texas ornithology and to the students and colleagues who have had the benefit of his lights.

Ornithology Class

Doc's undergrad course in ornithology was held in a Nagle Hall first-floor lab with long tables and an abundance of cabinets containing thousands of bird skins that helped comprise the Texas Cooperative Wildlife Collection. When class convened, students would file in, take their chairs at the tables, and Doc would hold forth in front of the lab, with a white board behind him and his teaching curriculum notes set out in front of him on the first table row. The curriculum had a healthy dose of avian taxonomy - orders and families of birds - and Doc's habitualized routine,

stemming no doubt from the years of having repeatedly taught the same material, was to read from his notes, complete his thought as he gazed out through his horn-rims above the heads of the attentive class, and then turn to the board to write out whatever orders, suborders or families that were the topic du jour.

Remember that I said I'm a wise-ass? I always made a point of sitting at the front table whenever the class convened. During one particular lecture, as Doc finished a thought with his typical focus and turned to the board to write out an order, say *Pelecaniformes*, I reached for his class notes (hell, they were sitting right in front of me, like an attractive nuisance!) and quietly flipped several pages forward. It was a wise-ass prank, and several students saw me do it. We all waited in anticipation to see what he would do. Would he pick up prank? Maybe erupt angrily? Maybe assign some extra work to the perp?

Well, when Doc finished his stint at the board, he turned back around and picked up from exactly the same spot on the page that he'd left. Except now it was several orders and numerous families ahead in the taxonomic rank. Without skipping a beat, Doc launched in to the characteristics of, maybe it was *Caprimulgiformes*. The truth is, it's been a long time and I don't remember what orders were involved… suffice to say, it was a big gap! Those who'd seen me flip the pages looked at me expectantly, waiting for me to make things right, which I did by sheepishly confessing to what I'd done. To his great credit, instead of getting mad, Doc actually got a hearty laugh out of it! And thankfully, my wise-ass prank didn't create a lasting stain on my tenure at Nagle Hall.

Rio Corona, November 1975

I was accepted into a Master's program under Doc Arnold in the Fall of 1975, and began my academic class work that semester. I'd have to look at my transcripts to remember what classes I took, but one thing I remember well is a field trip we took to Rio Corona in Tamaulipas, Mexico. The day after Thanksgiving in 1975, Doc, some other students and I jumped into his station wagon and headed south for Reynosa to cross into Mexico. The plan was to hit Rio Corona and bird the river's cypress/sycamore habitat and any associated habitats that looked enticing, camping along the way. It was my first introduction to the excitement of Neotropical birding.

We approached Reynosa late in the afternoon of November 28. Four hundred miles back behind us in College Station, the Aggies were playing t.u. at Kyle Field, and we were trying to listen to the broadcast on the car's AM radio. This was no piddly-ass football game! The Ags were ranked #2 in the nation at the time, while t.u. was #5. The further south we got, the weaker the radio signal got and the more all of us craned and strained to pick up the garbled play-by-play. Every now and then the atmospheric conditions and the radio signal would align and, through the crackle, we'd get the score. All of us, Doc included, whooped long and hard when we heard as we crossed the border that the Ags had won the game 20-10. A few more hours south from Reynosa put us on the Rio Corona, where we students added lifers galore and where Doc was perfectly in his element. My field notes show that we picked up 123 species, including a bunch of Mexican specialties. As it turned out, a few of the individuals we actually picked out of the vehicle's grill! Let me explain.

We were on the return leg of the trip, heading back north to the border through Nuevo Leon on a reasonably good two-lane road with brushy habitat close to the roadside margins. I was sitting shotgun, the other students were in the back, Doc was driving and we were making tracks. Out of the corner of my eye, I spied a covey of Northern Bobwhite that flushed from the edge of the road as the vehicle approached. Doc saw them, too. He zigged into 'em and we heard thumps. I said, "Hey, what about the quail?!" He said something to the effect of, "Quail?! Huh! I thought they were House Sparrows!" At the next gas stop, we pulled some bobwhite feathers from the grill and the front bumper. It was then that I realized that Doc's horn-rims served him well in the lab but maybe not so much in the field!

That drive back was long and sleep-inducing. To while away the time, I asked Doc about his PhD and what he'd studied. It was then I began to appreciate his academic pedigree and his bragging rights to having studied under one of the deans of American bird studies, George Lowery at LSU. Jesus! Talk about a Who's Who of ornithology! Jared Verner, Stephen Russell, Sidney Gauthreaux, Burt Monroe, Jr., Joel Cracraft, John O'Neill, Doug Pratt, just to name a few! And Doc's name right in there amongst them! Seizing the opportunity presented by a captive audience, Doc began to explain his work on Central American wren systematics and ecology and I very quickly got lost with the taxonomic details. You can only hear *Thryothorus* and *Thryomanes* so many times without zoning out in confusion, especially in a hot car speeding north to the border with quail blood on your hands!

Burt Monroe, Jr.

I was lucky to meet a few of Lowery's "offspring" during my tenure with Doc, and one of them was Burt Monroe, Jr. When Doc and I travelled to the 1977 AOU meeting in Berkeley, California, I was star-struck, tongue-tied and intimidated when I was introduced to big-gun ornithologists like Ned Johnson, Frank Pitelka, Joel Cracraft, John Emlen and Robert Ricklefs. Then, at one of the arranged dinners, I trailed Doc to a large round table, where sat an unimposing balding man of average height and possessed of a remarkably kind smile.

At the time, I wasn't aware of Burt Monroe, Jr., or his important role in avian distribution, taxonomy and nomenclature, or his lineage with Lowery at LSU, or his fierce dedication to University of Louisville basketball, but Doc introduced us and we had a great conversation in which I felt completely at ease. It was clear that Doc and Burt had a close and deeply respectful friendship. It didn't hurt that the evening's conviviality was helped along by the wine that was planted on all the tables.

Since I was soon to complete my MS, I was thinking of where I wanted to land for the PhD degree that I thought was inevitably in my future; that was one of the reasons I was sniffing around at the AOU meeting. In the course of our dinner conversation, I learned that Burt was receptive to bringing on a PhD student, especially one recommended by his old pal Keith. His receptivity grew considerably when I boldly went to another table to snatch their wine supply (ours had somehow bottomed out and needed replenishment). I think my single-minded determination to keep wine on our table was what sold Burt, who exclaimed to Doc, "I like this guy!" But at the time, I could not see going to Louisville, Kentucky for several years of PhD work. Thus, I missed a wonderful opportunity to study with a world-class ornithologist. Sadly,

the world lost a great scientist and soul when Burt passed away too soon in 1994. I'd have never met Burt without Doc's introduction, and I am deeply grateful for that.

Skins

I mentioned that Doc taught me how to put up bird skins. In the best sense of the term, he was a technician: careful, attentive, resourceful and intent on making the poor animal scientifically useful for decades to come. I sat with him many a time both to watch and to practice - scraping out fat stores from the inside of the skin, creating a body insert of just the right size and shape so that the drying skin would shrink to the approximate actual size of the living bird, cotton-wrapping the final mount just so to ensure it would dry properly, and a host of other techniques that contribute to a valuable specimen. Even doves and pigeons, with their thin, fragile skin, were no match for Doc's talents.

The techniques Doc passed along served me well when, in 1977, Dr. Nova Silvy, who was running a study for the critically endangered Attwater's Prairie-Chicken, presented three birds that had expired in a cannon-netting effort at a lek. Nova asked Doc who should put up the skins, as they'd likely be going to the Smithsonian National Museum of Natural History for their final resting place. I was grateful that Doc recommended me to Nova. I put the skins up as carefully as if Doc was watching over my shoulder and got them back to Nova. I lost track of them after that.

Then, in the mid-1990's, my wife and I took our two pre-teen sons to Washington DC and the Smithsonian. In a crap-shoot moment, I explained to a Museum staffer that I'd put up three specimens of an endangered species way back when, that I had understood they were to come here, and that we hoped to see them. He kindly took us back into the catacombs of cabinets and, after some searching, we stood on a step-ladder to pull out a tray of grouse specimens. There, shoulder to shoulder with several prairie-chickens put up by H.C. Oberholser (Oberholser, for crying out loud!) were three birds with my name on the Texas Cooperative Wildlife Collection tags tied to their legs. We have photos of my sons holding those birds. It's a very meaningful memory to me and it wouldn't have happened but for Doc.

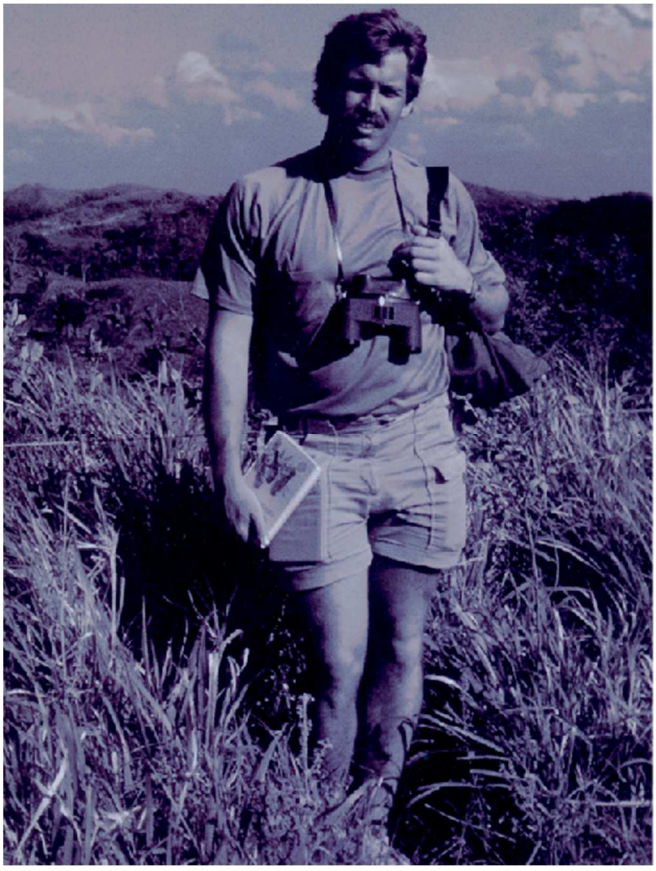
Fellowship

What cinched my entry into the MS program in 1975 was that Doc had gotten wind of a fellowship program offered by Texas Utilities Generating Company to conduct ecologically-based studies of their lignite mine, power plant and cooling lake near Fairfield, Texas. Doc suggested that I propose a study to evaluate the effects of mining and reclamation on bird communities, and I jumped at the opportunity. That's not to say I was a whiz at creating a snappy proposal, because I had no experience doing so at the time. But Doc stepped in and guided me with sound strategic advice, insightful study design and budget presentation ideas and overall excellent shaping of the proposal. I presented the proposal to the TUGCO steering committee, they accepted it and that fellowship supported me well for the entirety my MS program. Through the challenges of conducting field work in an active mining operation, Doc was the always-available sounding board, counselor, and trouble-shooter. And when it came time to analyze the data, make some sense of the results, and write (and re-write) and then defend my thesis, he was there, too.

I met and married my wife Cindy during the time I worked with Doc on my MS program. Amazingly, we're married still, 40 years later, and as part of this writing, I asked her of her recollections of our early years at Texas A&M. She recalled going to a dinner at Doc and Bev's house in College Station not long after we'd married. She reminded me of the conviviality and the graciousness that we enjoyed, along with a lovely meal. I think we brought a bottle of Lancers, which was then in vogue.

So, I end by saying that, in the finest sense of these words, Keith Arnold is an educator, a mentor, a counselor, a scientist, an ornithologist of the first degree. It was my great good fortune to have been guided to Texas A&M in the first place, and my even greater good fortune to have connected with Doc Arnold to guide me through so much of my educational experience while I was there. Thank you, Doc, I wish you only the best of great birds, great health and great happiness. With warm regards,

- Peter Cantle



Peter Cantle on Roatan Island, Honduras in 1977 (Photo by Larry Champagne).

Keith Arnold: a walking library of Ornithology

Dr. Arnold placed hawk specimens neatly along a table in a classroom at the Houston Museum of Natural Science while teaching a class on hawk identification. Several of us birders listened intently to Arnold's explanations about raptor identification as he held up specimens one by one. He held up two Accipiters, Cooper's and Sharp-shinned, and explained that they were hawks of woodlands, fast and maneuverable because of long rudder-like tails, but that they could be hard to tell apart. He pointed to the tails of each bird and showed how on a perched bird, the Cooper's hawk tail appeared rounded and a Sharp-shin tail appeared square but that we should be wary about feather wear on tails that could fool us with Sharp-shin. Then he talked about behaviors of the two birds, Cooper's seem to glide on shallow wingbeats and Sharp-shins dip their wings more vigorously, and that Cooper's usually perch on posts and Sharp-shins in trees….

The popular hawk identification field guides now available were yet to arrive back when Arnold discussed the nuances of hawk identification with us. Perhaps it was the way Arnold talked about bird identification, the clear and precise descriptions, the words of a man who loved birds and loved talking about them, a gentleman scholar and professor more interested in the process of learning than in the process of self-glorification, and extending knowledge rather than hording it, and so many other characteristics that branded Arnold's lecture into my brain.

I was not among the more than 2500 students who studied birds and earned degrees in Wildlife Science and Ornithology under Arnold's tutelage at Texas A&M University. Bird study for me was an avocation, but an avocation immeasurably enriched by attending Dr. Arnold's public seminars.

Despite Arnold's intense study of bird life, his momentous and numerous research publications, his extraordinary career as a professor of ornithology, and his lasting influence on bird research in Texas, Arnold was ever kind, generous, and helpful to any birder who needed guidance. I was frequently one of those birders.

A New York City reporter who wrote about a well-known author of bird field guides whom the reporter dubbed "a walking encyclopedia of ornithology". I thought, you haven't met Dr. Arnold, the "walking library of ornithology". A topnotch bird guide certainly knows a bird's markings, behavior, and vocalizations; Dr. Arnold knows all that, of course, but he also knows a bird's entire life story.

Following is a 2007 interview I conducted with Dr. Arnold about his life and work.

Clark: *How did you get interested in birds?*

Arnold: *I always had someone serving as a mentor. It started with my mother who read to me from the Thornton Burgess book series that included Old Mother West Wind (Dover Publications, New edition, $2.00). When I was in intermediate school, a biology teacher named Hazel Bradley took me under her wing. And, when I was a doctoral student at Louisiana State University, I studied under the famed ornithologist, George Lowery.*

Clark: *You've had a long tenure as a professor at Texas A&M, so do you call yourself an Aggie?*

Arnold (chuckles): *Absolutely. I always say I never went to school at A&M, but my blood runs maroon.*

Clark: *What is your legacy?*

Arnold: *My students. I've probably taught ornithology to more students than anyone else in the United States, and I'm proud of that. I'm also proud of the Texas Breeding Bird Atlas that I and Professor Robert Benson began. It's an all volunteer project, and we still have work to do to finish it.*

Clark: *Are you planning to revise Harry Oberholser's, <u>The Bird Life of Texas</u>?*

Arnold: *Yes, if I live long enough. We have a copy of Oberholser's original manuscript plus 50 years of field notes from observers and ornithologists like John Arvin at the Gulf Coast Bird Observatory in Lake Jackson.*

Clark: *What are your most memorable birding experiences?*

Arnold: *The rarest bird I ever saw was an Eskimo curlew at Galveston in the spring of 1962. I saw three of them, and that was the last valid record of the birds in North America. They may be extinct. I almost saw an ivory-billed woodpecker. Once was in 1962 in Louisiana, and another time was in 1967 north of Beaumont. A third time was in the 1970s when my department was doing an environmental study for the proposed Blue Hills Nuclear Power Plant in Jasper County. Members of our team reported an ivory-bill flying across a road, and we all hiked over there as fast as we could but couldn't find it.*

Clark: *What concerns you most about birdlife?*

Arnold: *At the rate bird populations are declining because humans are destroying habitat, I worry that a day will come when all we'll have are grackles and house sparrows. We must get more people interested in birds - not just birders - but everybody, or else there'll be no birds left.*

- Gary Clark

Professor, mentor, friend through life's journey

Dr. Arnold is a close and near lifelong friend. Not at all what I expected when we met in the fall of 1968. I was a sophomore at Texas A&M, and he was a young professor of ornithology in the Wildlife and Fisheries Science Department. I was a fifth generation Texan, and he was a Yankee from Michigan. But at least he had a Ph.D. from LSU, so he had spent some time in the South. We did share a deep interest in birds, however. I had recently visited Venezuela during two of the previous four summers, and he had spent the better part of two years in Costa Rica. He spent much of his spare time in the range (collections area), building up the bird collection from the humble beginnings he had inherited as Curator of Birds. I loved the range, and spent my spare time looking at birds I hoped to see one day and examining the details I had only read about, like the powder down of herons and the combed claw of the Pauraque.

Dr. A was always trying to get me to put up specimens for him, but I was way too slow. He always had more birds than time to prepare them, in spite of the fact that he could prepare a warbler skin in less than ten minutes. He encouraged all the students to salvage birds, and between that and the various research projects by a host of graduate students that brought in specimens, there was always a shortage of freezer space even with the walk-in freezer. One student was collecting Sandhill Cranes and doing stomach and crop analysis. Of course, Dr. A refused to let a single bird not be kept and prepared. The freezer held more than 20 of the big birds when the power went out over Christmas break. When it was discovered, the cranes were thawed and the insides were green, red and black with mold. Yet Dr. A insistently kept every single stinking crane, and enlisted me and other students to skin out the putrid birds. But he did put up each one after it was skinned, which was no small task.

I did not join his infamous snipe crew until after they had perfected the proper technique to catch the crepuscular marsh-loving shorebird. Apparently there was a steep learning curve, and in frustration he once had the technicians lay the nets across the marsh grass in hopes the birds would land in them. I'm glad I missed that net cleaning session. Becoming a member of the snipe crew brought me into much more regular contact with Dr. Arnold. He eventually grew to trust me with managing the crews and gave us a great deal of latitude as to when and where we would catch snipe. He also allowed us to put up nets for other species, and I was able to band and work with many species other than snipe.

I don't think Dr. Arnold was ever a scout or a camper. Having grown up in the Depression, living and traveling in a Spartan fashion was just normal, I suppose. So when we headed on a lengthy overnight or weeklong field trip he seemed to assume everyone would take what they needed, even though he might be the only one who knew what to expect when we arrived at our overnight camp site. He always seemed to be comfortable and prepared, but we students soon found out that we had better prepare ourselves because no one else would. I recall one night I slept on top of an International carryall and was almost blown off it by the wind. The Barn Owls kept me up all night, flying low over the carryall roof and screeching as well. Dr. A had a nice night in a tent with a cot! But he was concerned when it came to making sure we had all prepared the mist nets, poles and other gear we would need for banding and collecting specimens. He certainly had his priorities straight.

Not many people are credited with a first U.S. bird record, but Dr. Arnold has one to his credit. It is one of the most bizarre first U.S. and first Texas records ever. It was a Paint-billed Crake. This South American rail is somewhat similar to a Sora. One of his students was a fur trapper who worked a few creeks near campus, often trapping mink. He caught the rail in a trap and brought it to Dr. Arnold, and told him he had brought him a Sora from his trap. Dr. A had him lay it on a table in the range outside his office, and said he would skin and prepare it after a class he was headed to. I happened to see it and ask what it was. Dr. A said a Sora and told me the story. I glanced at it and wondered why I did not realize it was a Sora, and I went to class. Later in the day, I heard through the grapevine it was not a Sora and Dr. A and others were scouring bird books looking for its identity. Before the day was out he had identified the rail. But then the research began to understand how it could have ended up in College Station, Texas. Turns out that even though the bird had a rather restricted range in northern South America, there were plenty of peculiar records at distances equal to or greater than that of College Station. Why this species has such a notorious vagrancy pattern is still unknown, but figuring out the bird's identity was about as great a feat as the bird's dispersal.

I left TAMU academia and wildlife science to work in a family business in Houston. Dr. A did not "give up" on me and continued to communicate and divert wildlife related problems, people and research my way, which I pursued in my spare time. It was 18 years later before I returned to the wildlife field full-time, and Dr. A continued to encourage and support me. That has never wavered through all these nearly 50 years. Maybe there have been more acclaimed professors, but never has there been a finer educator or a better friend. He excels above all others in his dedication to his TAMU students and his friends. I am blessed to have had him in my life.

- G. Fred Collins

L-R: Vic Diersing, Fred Collins and Ben Dial
Rio Corona, Mexico, March 1972 (photo by Robert Thomas).

Thoughts about Keith Arnold

I first met Keith Arnold, sometime in the early 1970s, through play. I had no scientific inclinations, and my interest in birds extended no further than birding. Yet, Keith, as one of Texas' preeminent Ornithologists, worked hard to balance his academic interests with those of the recreational public. Through his generosity of time and spirit, often shared with me, I came to see birds as far more than a recreational pursuit. Through birds, I came to see the natural world, writ large.

Keith and I worked together on a number of occasions; for example, we served together on the Texas Birds Records Committee. I helped Keith as he organized the first Texas Breeding Bird Atlas, an accomplishment for which he has received not nearly the recognition that he is due. And, as the Texas Ornithological Society branched out into land acquisition with the Sabine Woods purchase, Keith offered consistent support and advice to those of us on the front lines of those efforts.

Keith reviewed the Christmas Bird Count reports for decades. I compiled CBCs in the early days, and I often had exchanges with Keith about the validity of rare bird reports. One of my favorite Keithisms was his response "unbelievable, if true" to one over-the-edge rare bird.

We have been blessed to have enjoyed a scientist in our state who from the very beginning saw value in the notion of citizen science. For that, Texas birds will always be grateful to Keith Arnold and Texas A&M. The university and his department could have easily isolated themselves from those of us who played with birds, yet Keith always embraced us and our pastime. Thanks, Keith, for being so generous to and considerate of the birders of our state. We will always be in your debt.

- Ted L. Eubanks, Jr.

Lessons taught and lessons learned

In August of 1977 I found myself in College Station holding a diploma that said I had earned an undergraduate degree in Wildlife and Fisheries Sciences. I had no job, but because I had been encouraged to volunteer by many people, I took the opportunity to work for Dr. Arnold.

Dr. Arnold taught me many things during the two years I worked for him. The first lesson began the day I walked into his office and was greeted by the sign "A clean desk is the sign of a sick mind"! I adhere to that philosophy to this day, and although repeating that phrase over the years has resulted in many laughs, it is the least important lesson I learned from him. To tell the truth, it took me a few years after I left the Wildlife Department for many of his lessons to sink in and make a difference in my life.

Dr. Arnold believed in hard work and I believe I worked hard for him. However, he also showed me that work was not everything. People needed to have other interests and outlets in their lives. I was single and my family was several hundred miles away so he included me in some of his family activities. It was only later that I realized he had a giving and compassionate side that he used to help make me a better person.

Dr. Arnold taught me to keep a notebook; a practice I do to this day. Never has that been so important as these last few years as my mind sometimes forgets important activities if I don't write them down. It has been interesting to go back to the old records to remember what I was working on, what I saw or who I was with. Sometimes it was just a grocery list, but other times I got somewhat philosophical.

Dr. Arnold was absolutely obsessed with collecting aluminum cans in 1977. He walked to work most days and he arrived with his pockets filled with crushed cans. The same thing happened on his way home. Soon I was doing the same thing. It was small scale, but it added up. Over the years I think it did make a difference, and it kept our small portion of this planet a little cleaner.

He was CEO of "PHI" (Pepsi Haulers Inc.) and he recruited me to help. This was the soft drink concession on the 2nd floor. When the ice box ran low, one of us would make a soft drink run to Skaggs. It was fun, but not until some years later did I appreciate the lesson. Get involved. Do something nice for others. Make a difference.

I was given many opportunities while working with Dr. Arnold. I spent many hours with him and his students banding blackbirds at the Dairy Center, scooting through wet culverts checking swallow nests and dodging snakes, and netting swallows so we could dye them bright colors and follow their movements. He taught me to reload shotgun shells so we could collect specimens and then taught me to prepare those specimens for the bird collection. I was able to travel with him to the SWAN meetings and interact with his peers. And of course stop along the way to look for birds in farmland fence rows or abandoned homesteads on the high plains. Those are days I treasure now, but I suspect I was less appreciative of them at the time as we often are when we are younger. In hindsight I was foolish for not realizing that I worked for a true field biologist, a perfectionist when collecting specimens or measurements or recording movements.

He was a man who collected data because it needed to be collected so that everyone would know a little more about the world we lived in.

Throughout my life I have been blessed with mentors who have helped me mature, but only two or three have actually taken a chance on me. Dr. Arnold is one of those people and I owe him a debt I can probably never repay. I am a better man now for many reasons; not the least of which are the things Dr. Arnold taught me early in my professional career at a time in my life I needed help and guidance. Thank you Dr. Arnold for all you did for me, and for all of your contributions to science.

- Nick Garza

Some memories of early times with Keith

My memories of early times are somewhat fuzzy so I will apologize ahead of time for whatever discrepancies in dates or events that may arise.

I remember meeting Keith when he was a graduate student and I had just made my early trips to Peru. I was an undergraduate at the University of Oklahoma and was visiting LSU to talk to Dr. Lowery about the specimens that I had brought back. I remember talking to the graduate students like Keith, Burt Monroe, Stew Warter, Steve Russell and others. They were all involved in studies of Central American birds and getting ready to head out into the field. At the time, Keith seemed more interested in the systmatics of Central American wrens. They were all kind to me and despite the fact that I was from somewhere else and a youngster, they included me in their conversations and plans. I was always invited to be part of this group that often went to the Lowery's home on Sunday afternoons. I am sure that Keith has many fond memories of those times.

I am originally from Houston, Texas and my earliest enthusiasm was for Texas birds, so when Keith came to Texas A&M, I believe in 1967 to work, we had even more in common. In addition, my present wife, Letty was a graduate student at A&M at the time so I had even more occasion to visit. One of the first contacts I had with Keith's involvement with Texas birds was Don Bleitz' discovery and photograph of the Eskimo Curlew on Galveston Island. Keith and I and others from LSU went with Dr. Lowery to see the bird. After Keith came to Texas A&M he became more involved in Texas birds and began to travel around the state and to work on building the collection there. He went with students to one of my favorite places, the Trevino ranch near Laredo where he collected the first Texas specimen of the Rufous-crowned warbler.

Several years ago, Keith and Bev bought one of my paintings, a portrait of a Jivaroan man from northern Peru. He is wearing a headdress of bird feathers with a whole plum-throated cotinga attached. This remains one of my favorite paintings and I will always take pleasure in knowing that it lives with them. I treasure Keith's friendship and the many birding memories that we share.

- John P. O'Neill

O'Neill in the Pampas Rio Heath, Peru in the 1970's (Photo by Reyes Rivera).

My professor and friend, Dr. Keith Arnold

Nearly 43 years ago I made my first move from Houston to Aggieland to start the undergraduate program in WFS. My goal then was to earn a doctorate degree and become a waterfowl biologist with the USFWS. Very soon I met Dr. Keith Arnold and my studies included his ornithology course, WFSC 402, and my interests gradually shifted to non-game ornithology, ecology, and evolutionary biology. I learned a great deal from Dr. Arnold and spent my undergrad summers in the Texas Cooperative Wildlife Collections (today known as the Biodiversity Research and Teaching Collections, BRTC) – back then housed on campus in Nagle Hall – preparing bird skins under his tutelage. Dr. Arnold's skins are easily recognizable throughout these collections because of the quality of their preparation and attention to detail. Simply put, no one does it better than Dr. Arnold. Keith, with less ambition you would have made a fine surgeon.

Seriously, I am only one among many folks throughout Texas and elsewhere whose lives have been favorably influenced by the ornithologist, Dr. Keith Arnold. My good friend Fred Collins comes to mind, as well as San Angelo ornithologist Dr. Terry Maxwell. For several summers years ago, Fred and I and others like Ted Eubanks banded literally thousands of Laughing Gull (*Leucophaeus atricilla*) chicks on Pelican Island under Dr. Arnold's permits. It was Keith's study – we were his field birder minions – and the study yielded enough data to show that juvenile Laughing Gulls hatched on the Upper Texas Coast spend their first year or two around the Pacific coast of Guatemala… fascinating and previously unknown information. Dr. Arnold also assisted me with obtaining my own Master banding permit in 1981. My good friend Dr. Byron Stone and I discovered that we each assisted Dr. Arnold with netting and banding nesting Henslow's Sparrows (*Ammodramus henslowi houstonensis*) in Houston in May 1981, although we didn't know each other at the time! I could go on and on.

At any rate, my ornithology graduate career didn't work out and I got married and found myself applying to medical school. As fate would have it, A&M accepted me and I made my second move from Houston to Aggieland in August 1985. Very soon after that, my wife Patricia and I reunited with Keith and Bev Arnold in a continuing warm friendship that has endured to this day. As expected, med school was more intense than anything we'd ever done before. Our first son, Daniel, was nearly two years old when I started and we had no family nearby for babysitting. It was the Arnolds' daughter, Jennifer – then a teenager – who filled that niche and made it possible for Patty and me to enjoy an occasional evening out together. I remember those days of driving to the Arnolds' home in College Station to pick up Jennifer for an evening of babysitting. I can't remember what we paid her but I'm sure it wasn't enough!

On a final note, two years before my first stint in College Station — 45 years ago this year — Dr. Arnold gathered several other keen observers statewide, among them names familiar to all of us, like Warren Pulich, Fred Webster, Frances Williams, Dr. James Scudday, Ken Seyffert, ABA founder Jim Tucker, Ro Wauer, Dr. Richard Albert in Alice, Dr. Dean Fisher in Nacogdoches, and Ben Feltner in Houston, to establish a review committee for rare birds reported in Texas. The Texas Bird Records Committee (TBRC) was thereby created and born under Dr. Arnold's

initiative, and since then the committee has evolved to become one of the finest anywhere. Perhaps the most amazing thing of all is that Keith is still on the committee and has served every one of those 45 years! Besides Keith, the last of those original members left the TBRC 25 years ago. That was Frances Williams in 1992.

To wrap up for you Keith, I bow and remove my hat in your honor for all you've done for me and so many others as professor, mentor, advisor, you name it!... but most of all as a kind and generous friend.

- Randy Pinkston

Thinking of Dr. Arnold

When asked for my thoughts regarding Doctor Keith Arnold, I thought…

I thought of Dr. Arnold when I named my daughter, Wren.

I thought of him when I saw one of my students drawing in the margin of his biology notes. I had done the same in Dr. Arnold's class.

I thought of Keith when I saw my first species of wren in Costa Rica. It was a Rufous-naped Wren.

I was honored when Dr. Arnold chose me to lead the "Snipe Banding Crew" for a couple of years. For the first time, I got paid to work with birds. The pay surely helped with college expenses, but the knowledge I gained and the privilege of working with Keith and the other members of the Snipe Crew, was life changing.

I was surprised and happy when, a few years ago, one of the former members of the Snipe Crew, Randy Pinkston, asked me to donate one of my paintings (a Rufous-capped Warbler) to celebrate and honor the 40 years that Dr. Arnold has served with the Texas Bird Records Committee.

I thought it was exciting when Dr. Arnold allowed me to be a subpermitee of his banding license so that I could band birds with my elementary and middle school students.

I have always thought of Keith as a mentor and friend.

My association with Keith Arnold has influenced my thoughts regarding education, conservation, and birds.

- W. Dennis Shepler

Keith Arnold: teacher, author, mentor, boss, friend

Dr. A was my graduate ornithology teacher and a welcomed member of my Master of Science graduate committee. As I struggled to analyze my field data and write my thesis, he hired me as his research technician for his blackbird and Cliff Swallow projects in 1981. He made me promise that if he hired me that I would complete my Master's Thesis. With his help, guidance and some ruffled feathers, I completed my thesis in 1984. My continuing gratitude to him. I left his employment in May 1985 after my second son was born.

We had four successful years together and with his guidance, financial support and help from his students, we banded thousands of blackbirds, from Great-tailed Grackles to Brown-headed Cowbirds at the TAMU Dairy Farm, and Cliff Swallows in the Somerville, TX area. Entering those cement culverts in the pre-dawn darkness to plug the nest holes with cotton was an amazing adventure. Finding wall-climbing rat snakes in the mud nests, behind the cotton plug certainly gets your heart pounding at dawn. We gathered some amazing data and published two papers together:

Sikes, PJ and KA Arnold. 1985. Movement and mortality estimates of Cliff Swallows in Texas. Wils. Bull. 96: 419-425.

Sikes, PJ and KA Arnold. 1986. Red imported Fire Ant (*Solenopsis invicta*) predation of Cliff Swallow (*Hirundo pyrrhonota*) nestlings in east-central Texas. SW. Nat. 31: 105-106.

One of my favorite memories was in my first year working for him. I was busily computerizing many years' worth of bird banding records and needed space in a file drawer to keep the paperwork. I had no space for a cabinet in my tiny office, so he cleared one drawer of his many file cabinets. When I asked how he made room, he proclaimed, "I threw away my correspondence from dead people".

I was very pleased that he published the Lone Pine Field guide, "Birds of Texas" in 2007. This was an ongoing dream and many years of hard work. I keep this book handy as we have many birds in our yard, so I think of Dr. A often.

Thank you for being an influential part of my life and I look forward to Christmas family letters, when you have the time!

- Patricia Sikes

My big owl in Taiwan

I have been working on Tawny Fish Owls since my overseas study with Dr. Arnold for my PhD program at Texas A&M beginning in 1992. The Tawny Fish Owl is the largest owl in Taiwan, as well as the only fish owl we have in Taiwan. There are four species of Fish Owls in Asia. The major work for my Ph.D. dissertation was to find out what the owl ate, how long a section of stream they occupied, where they roosted and bred, and why they harass fish farms. The following were some of the results we found.

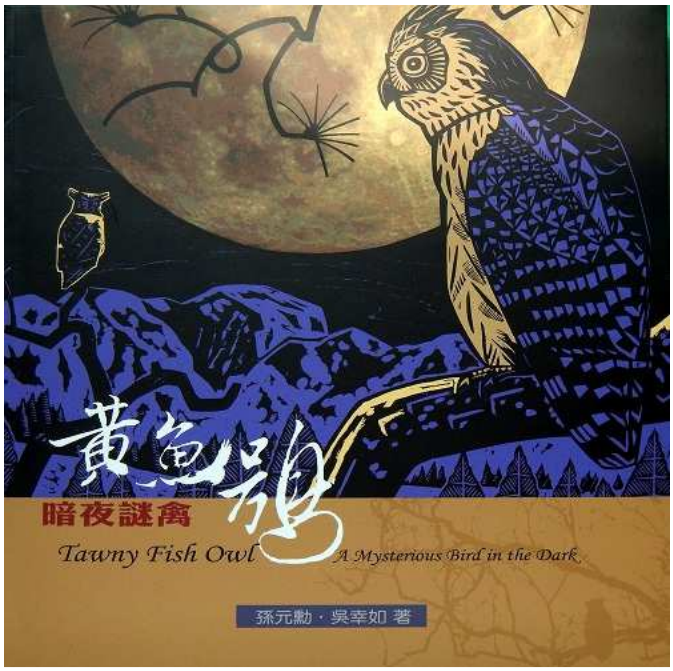
There are four and three species of fish owls in Asia and Africa, respectively (Tawny Fish-Owl is on middle perch, on right).

Crab remains leftover of tawny fish owl.

A tawny fish owlet at a big fern on a large tree.

In terms of fish predation, we examined the conflict between cold-water fish farmers and endangered Tawny Fish Owls in Taiwan. From 1994 to 2000 we surveyed 144 fish farms to assess the level of fish predation by Tawny Fish Owls, and documented farmers responses to owl predation. From July 1994 to May 1996 studies were conducted at five farms on Nanshih stream in northern Taiwan, and Tachia stream in central Taiwan, to determine the size of fish taken by the owls and factors affecting predation rates. Owl predation was reported at 25 (17.4%) of the fish farms. Most farmers claimed owl predation was most frequent during winter, then spring, fall and summer. At 16 farms owls were trapped with steel leg-hold traps or mist nets, and 10 owls were found drowned or floating in the fish ponds on eight farms. At each of the five studied fish farms, the owls took 8-131 (0.04-0.66%) of some 20,000 fish available in a year. As the water level in streams increased, owls visited fish farms more often than expected. Owls foraged more on clear nights and caught 101-400 g fish more often than expected.

A male tawny fish-owl caught by a fish farm owner in 1989.



Book published and film released about Tawny Fish Owls by Sheipa National Park

When I went back to Taiwan, I found a teaching job at the university near my hometown and continued my Fish Owl research until last year (2016). During that period of time, I had four students working on the Fish Owl for their Masters program. In 2014 we published a book and a film about this owl and our work for Sheipa National Park.

A pair of Tawny Fish Owls at Sheipa National park.

Offspring of the pair at left.

- Yuan-Hsun Sun

A generous professor

A couple of years out of college, I found myself back in Texas where I grew up, trying to figure out my next steps. Having spent time with raptors as an environmental educator after enjoying my undergraduate ornithology class, I wanted to find a way to keep exploring this field. I began researching graduate programs in Texas so I could stay close to home and found Texas A&M's Wildlife and Fisheries Sciences Department. I homed in on Dr. A immediately. I was so excited about the program and emailed my resume to him out of the blue, expressing my interest in his work. He wrote back right away and after some correspondence offered me a position as one of his teaching assistants for the next year. I was thrilled to become a member of his lab!

I learned a lot in that lab: how to prepare bird skins for the teaching collection and how to keep 30 undergraduate students interested in memorizing hundreds of birds and ornithology facts. I became a solid birder and learned how to jump over venomous snakes as I checked cave swallow nests under bridges and culverts all over Brazos County.

And, I enjoyed taking excursions with Dr. A and other students. Now, Dr. A is a stickler for the rules, and driving was no exception. He was always very careful to obey the speed limit, and on one trip to the Lake Conroe area, cars and trucks were routinely passing us on the left as we traveled to our destination at a temperate speed. I noticed him motioning to these drivers and leaned forward slightly to get a better view of him giving each speeding vehicle what I've since termed the "emphatic thumbs down," a move that involved his entire left arm. The other student passenger and I were thoroughly entertained all the way to Lake Conroe and back.

After three years of teaching labs, field work, skins and excursions, I finally defended my thesis and graduated, moving on shortly thereafter to environmental and land use law and policy, but I am forever grateful for my experiences at Texas A&M and in Dr. A's lab. He gave me a wonderful gift all those years ago when he offered me, green as I was, a chance to pursue my studies with him, and I thank him heartily for it.

- Meg Byerly Williams