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STATUS OF AMERICAN COOT *FULICA AMERICANA* (GRUIFORMES: RALLIDAE) WINTERING IN MEXICO

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RESUMEN

Determinamos tendencias poblacionales y sitios importantes de invernación para la gallareta (*Fulica americana*) en México, para la cual prácticamente no existe información en el país. La distribución de las poblaciones a largo plazo (1960-2000) invernando en el país fue: costa del Golfo de México (68%), costa alta del Pacífico (20%), altiplano central (7%), altiplano norte (3%), costa baja del Pacífico (2%). La distribución a corto plazo (1991-2000) fue 53%, 30%, 8%, 5% y 3%, respectivamente. Los números estimados de gallaretas decrecieron desde 1981 hasta 1997; sin embargo, no se detectaron tendencias significativas en el largo o corto plazo en la población a escala nacional. La media a corto plazo, de alrededor de 210,000 gallaretas, se encontró 52% debajo ($P < 0.05$) de la media a largo plazo, de alrededor de 450,000. En la costa del Golfo de México, se detectó una tendencia negativa (-2.4% anual, $P < 0.05$). Otras regiones no mostraron tendencias significativas. La gallareta se encuentra ampliamente distribuida en el país, pero las grandes concentraciones se encontraron en tan sólo unos pocos sitios. Durante 1991-2000, se registraron gallaretas en 76% de los sitios de conteo, pero seis sitios por sí solos mantuvieron el 71% del total nacional (deltas de los ríos Tamesi y Pánuco 17.8%, Ensenada Pabellón 15.6%, Topolobampo 9.1%, lagunas de Campeche-Yucatán 17.8%, lagunas de Tabasco 6.7%, Laguna Madre 3.8%). Los primeros tres sitios califican como humedales de importancia internacional ante la Convención Ramsar, al tener en promedio más de 20,000 gallaretas. Las causas de los decrementos en números, especialmente en la costa del Golfo de México, el tamaño de las poblaciones residentes y el papel de la especie como indicador del estado de conservación de humedales deben ser objetos de investigaciones futuras.

Palabras Clave: gallareta, tendencias poblacionales, distribución, conservación, México.

ABSTRACT

We determined population trends and important sites for American coot (*Fulica americana*) wintering in Mexico, for which population information in the country is practically inexistent. The long-term (1960-2000) distribution of the population wintering in the country was: Gulf of Mexico coast (68%), upper Pacific coast (20%), central highlands (7%), northern highlands (3%), lower Pacific coast (2%). The short-term (1991-2000) distribution was 53%, 30%, 8%, 5% and 3%, respectively. Numbers decreased from 1981 until 1997, but no significant long-term or short-term linear trends were detected in the overall national population. The national short-term average of around 210,000 American coot was 52% below ($P < 0.05$) the long-term average of around 450,000. In the Gulf of Mexico coast, a significant decline was detected (-2.4% per year, $P < 0.05$). Other regions showed no significant trends. American coots are widespread throughout the country, but large concentrations occur only on a few locations. During 1991-2000, American coot were recorded in 76% of the count sites, but six sites alone held 71% of the national total (Tamesi and Pánuco river deltas 17.8%, Ensenada Pabellón 15.6%, Topolobampo 9.1%, Campeche-Yucatán lagoons 17.8%, Tabasco lagoons 6.7%, Laguna Madre 3.8%). The former three sites qualify as wetlands of international importance under the Ramsar Convention, by having on average more than 20,000 American coot. The cause for decreasing numbers, especially in the Gulf Coast, the extent of resident populations,

and the role of the species as an indicator of wetland health should be subject to further investigation.

Key Words: coot, population trends, distribution, conservation, Mexico.

INTRODUCTION

Mexican wetlands function as vital stopover and wintering grounds for nearctic waterfowl (Wilson & Ryan 1997) arriving via the Pacific and Central flyways (see Baldassarre 1994). Such areas supply the resources needed for spring migration and the following breeding season, thus having a significant effect on recruitment (see Raveling & Heitmeyer 1989). Moreover, Mexico is home to resident waterfowl populations that depend entirely on resources available therein. Unfortunately, wetlands in the country are subject to constant degradation, with up to 95% of the land area affected by erosion and 80% by biological degradation (Arriaga-Cabrera *et al.* 2000).

The importance of waterfowl in ecological processes, as indicators of wetland health and for their cultural and aesthetic value, is widely recognised (see Weller 1999). Additionally, waterfowl-related activities in North America, such as observation and hunting, are economically important, generating around US \$20,000 million every year (Berlanga 2001). Annual harvest of American coot (*Fulica americana*) alone has averaged over the last 3-4 decades c. 8,000 birds in Canada and 880,000 in the U.S. (Eddleman *et al.* 1998). In recognition of these circumstances, several conservation and research initiatives have been developed for the region, the most important being the North American Waterfowl Management Plan (NAWMP) (NAWMP 2002). This initiative is supported by long-term population monitoring programs in the U.S. and Canada, with annual updates on waterfowl production and population estimates (see USFWS 2001). However, even when raw long-term count data exist, studies on the status of waterfowl populations in Mexico are largely missing from the literature. This is also common for other vertebrate groups in the country, for which conservation efforts operate without a defined technical, theoretical and institutional framework that responds to regional and national priorities (Berlanga 2001). Nevertheless, recent changes in Mexico's political structure have produced a rearrangement of the national wildlife conservation scheme, and for the first time, a waterfowl conservation framework is being developed (National Strategy for the Conservation, Management and Rational Use of Waterfowl and their Habitats in Mexico), which responds to NAWMP and national wildfowl conservation requirements. Such initiative will guide conservation efforts of government Institutions and will greatly influence how funding is allocated to waterfowl research, conservation and management projects in the country.

To accurately define priorities and actions, baseline data such as the current status of populations should be the basis of such conservation planning exercises. By assessing population trends, conservation priorities could be broadly defined, and scarce funds distributed more efficiently to populations requiring immediate action. Unfortunately, waterfowl population data for Mexico is practically absent from the literature (see Pérez-Arteaga *et al.* 2002a). The same applies specifically to American

coot, for which virtually no distribution, population, or harvest information exists in the country (Alisauskas & Arnold 1994). From 1825 until 1992, only two studies with direct reference to American coot in Mexico were published, but neither addressed ecological or population aspects (see Rodríguez-Yáñez *et al.* 1994). Alisauskas & Arnold (1994) analysed American coot count data for north-western Mexico, but data for other regions was not available.

Given the need of information for American coot populations in Mexico, we here analyse long-term count data to identify population trends and important sites for the species in the country, which could be useful for ongoing conservation planning and management efforts in the country. We also identify important sites for the species and those meeting Ramsar Convention's criteria to be designated as wetlands of international importance, based on American coot count data.

METHODS

Data

Analyses were based on data from the U.S. Fish & Wildlife Service mid-winter waterfowl counts in Mexico. Such data consist of numbers of birds counted on discrete wetlands through aerial surveys. Species counted include American coot, ducks, geese, shorebirds, and other conspicuous species. The surveys have been conducted during January (although not in every year) since 1947 (e.g. USFWS 1997). The survey is carried out separately in three regions: the Gulf of Mexico coast, the interior highlands (including northern highlands, central Highlands, lower Pacific coast), and the upper Pacific coast (see Saunders & Saunders 1981). From the beginning of the survey until 1984 the counts took place irregularly. Since 1985, counts have been carried out every three years, the most recent survey being conducted in 2000. For the present analysis, we used American coot count data from 1960, when the coverage of the census was well established.

Large concentrations and sites meeting Ramsar criteria

Sites with the largest concentrations of American coot and potential Ramsar sites were identified using count data from the last decade only (1991-2000). Criterion 6 of the Ramsar Convention on Wetlands states that "a wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of waterbird" (Ramsar Bureau 1999). However, as no population estimate exists for American coot (see Delany & Scott 2002), the Criterion 5 threshold of a site regularly holding 20,000 birds applies (Ramsar Bureau 1999). Here, we identified potential Ramsar sites only if the average of the four counts for 1991-2000 in that site was greater or equal to 20,000 American coot. The use of fewer than five counts and non-consecutive count years is allowed by the Ramsar Convention, where there are particular constraints on national capacity to undertake surveys (Ramsar Bureau 1999, see Pérez-Arteaga *et al.* 2002b). The sites which

consisted of distinct wetlands systems (eg. Campeche-Yucatán lagoons) were not identified as potential Ramsar sites, even if they met the required threshold.

Population trends

Population trends were assessed over the long-term (1960-2000) and short-term (1991-2000). Trends were assessed using TRIM v3.04, a program developed for the analysis of count data derived from wildlife monitoring schemes (Pannekoek & van Strien 2000). The program uses loglinear models to produce annual population indices and population trends from time series of count data (Pannekoek & van Strien 2001). Large-scale wildlife monitoring schemes are often characterised by the presence of many missing values from individual sites within the scheme. In order to combine the counts from individual sites to derive a national or regional population index or trend it is necessary to account for the missing counts. TRIM provides a framework for so doing by producing a model based on the existing counts and then using this to predict those that are missing. National or regional population indices and trends can then be calculated using a complete dataset where the missing counts are replaced by predicted counts from the model.

For the American coot data, TRIM was used to fit a loglinear model to the observed counts, where each count was expressed as a function of a site factor and a separate year factor for each survey year (linear (switching) trend model, selecting each year in which there was a survey as a changepoint) (for a full explanation of the model, see Pannekoek & van Strien 2001). The model was then used to predict missing site counts within the survey years and annual population indices were obtained for each survey year using the predicted counts to replace any missing values.

A population index is simply the ratio between the total count for a given year and the total count in the base year, representing the increase (or decrease) with respect to the base year (Pannekoek & van Strien 2001). In the present analysis, the base year was 2000, for which indices were set to 100. Average annual changes and simple measures of long-term (1960-2000) and short-term (1991-2000) trends, were obtained from the completed dataset by linear regressions of the log-transformed year totals on years. Only those sites with count data for 50% or more of the number of years in which the survey took place were used for the assessment of trends, to reduce the number of missing values that had to be imputed by the model (see Underhill & Prys-Jones 1994). Of 147 sites with American coot data, 32 sites met this requirement. These sites were considered representative of the entire set, as they included 81% of the total number of American coot counted in Mexico during 1960-2000.

RESULTS

American coot is widespread throughout Mexico. During the last decade, individuals were registered in 76% of the count sites (Fig. 1). There were large aggregations in a few areas, with low numbers being recorded elsewhere. Four sites in the Gulf of Mexico

coast and two in the upper Pacific coast registered counts of more than 10,000 birds, accounting for more than 70% of the National total (Table 1, Fig. 1). Three of these sites also meet the Ramsar Convention's criteria to be designated as wetlands of international importance, based on American coot data alone.

Average counts, distribution of the national population over the different regions, and population trends of American coot in Mexico are presented in Table 2. Table 3 shows the overall counts and population indices of American coot. Average numbers of American coot were calculated using data from a subset of sites which complied with the criteria for assessing trends (see Methods), and should not be interpreted as total numbers in Mexico, but rather as parameters to aid in the interpretation of change. The average national count during 1991-2000 represents a 52% reduction ($P < 0.05$) from the long-term (1960-2000) average. The latest (year 2000) count was 46% below the long-term average ($P < 0.001$), but similar to the short-term mean ($P = 0.51$).

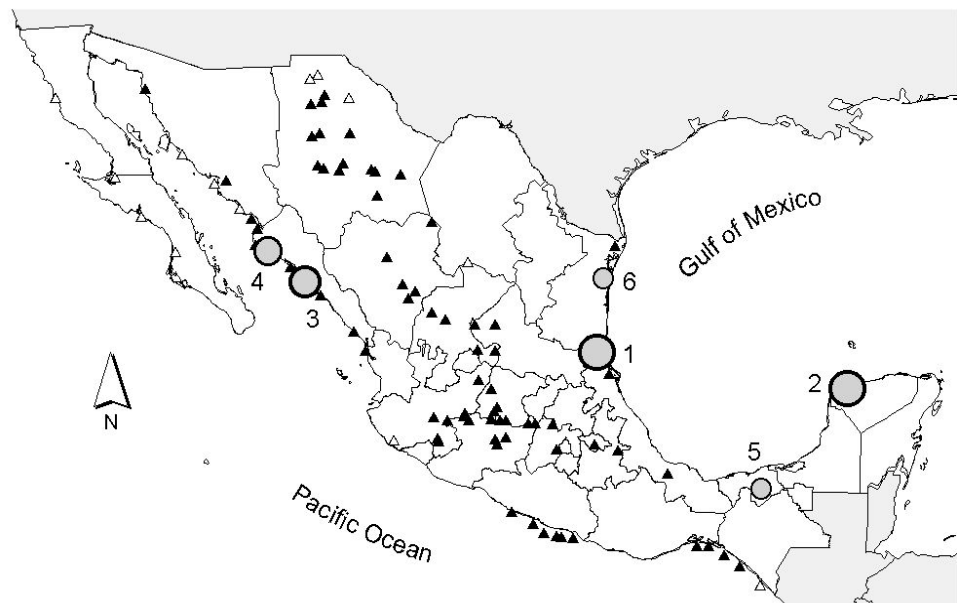


Figure 1

Sites with American coot average counts >10,000 individuals (1991-2000). 1 (Tamesi and Pánuco river deltas), 2 (Campeche-Yucatán lagoons), 3 (Ensenada Pabellón), 4 (Topolobampo), 5 (Tabasco lagoons), 6 (Laguna Madre). Size of circles is proportional to the average number of American coot on the site (see Results). Triangles represent sites surveyed during 1991-2000 (full triangles represent sites where coot were registered; empty triangles are sites with zero counts).

Table 1
Sites with average concentrations larger than 10,000 American coot during 1991-2000.

Site	Region ^a	Average count ^b	Proportion of total count	Potential Ramsar site
Támesis & Pánuco river deltas	GC	49,955	17.8%	YES
Campeche – Yucatán lagoons ^c	GC	49,747	17.8%	
Ensenada Pabellón	UP	43,698	15.6%	YES
Topolobampo	UP	25,607	9.1%	YES
Tabasco lagoons	GC	18,905	6.7%	
Laguna Madre	GC	10,624	3.8%	
All 6 sites		198,533	70.8%	

^a GC (Gulf of Mexico Coast); UP (Upper Pacific Coast).

^b Predicted counts from TRIM model (see Methods).

^c As the site is comprised of several distinct wetlands, it was not considered a potential Ramsar site.

Table 2
Average counts, distribution of the national total over regions, and trends of American coot in Mexico.

Regions	Long-term (1960-2000) ^a				Short-term (1991-2000)			
	Average count	% of total	Annual change (%)	Sig ^b	Average count	% of total	Annual change (%)	Sig.
National total	475,025		– 0.6	ns	216,229		– 3.0	ns
Northern Highlands	7,633	2%	– 1.1	ns	4,302	2%	– 2.1	ns
Central Highlands	29,146	6%	– 0.5	ns	16,587	8%	+ 18.3	ns
Gulf of Mexico Coast	373,116	78%	– 2.4	*	141,350	65%	– 0.4	ns
Upper Pacific Coast	65,130	14%	– 0.6	ns	53,990	25%	– 18.6	ns

^a Calculated from predicted counts from TRIM model (see Methods).

^b ns ($P > 0.05$), * ($P < 0.05$).

Large fluctuations in numbers of American coots occurred in Mexico throughout the study period (Figs. 2A, B). The largest variation in consecutive surveys occurred when the count rose from around 120,000 in 1969 to more than 610,000 in 1970, an increase of almost 400% (Fig. 2A, Table 3). The 1970 count was 784% above the levels recorded in 1968. Another prominent increase occurred from 1973 until 1976, a 342% rise in recorded numbers. The largest decline in consecutive surveys took place in 1967-1968, when numbers decreased by 88%, being the lowest on record. The largest count was recorded in 1976, when numbers reached almost 1 million birds; similar levels were recorded in 1981 (Fig. 2A, Table 3).

Even though no significant trends were detected for the overall population of American coot in Mexico (Table 2), a significant long-term decline was identified in the Gulf of Mexico coast population (Table 2, Fig. 2B).

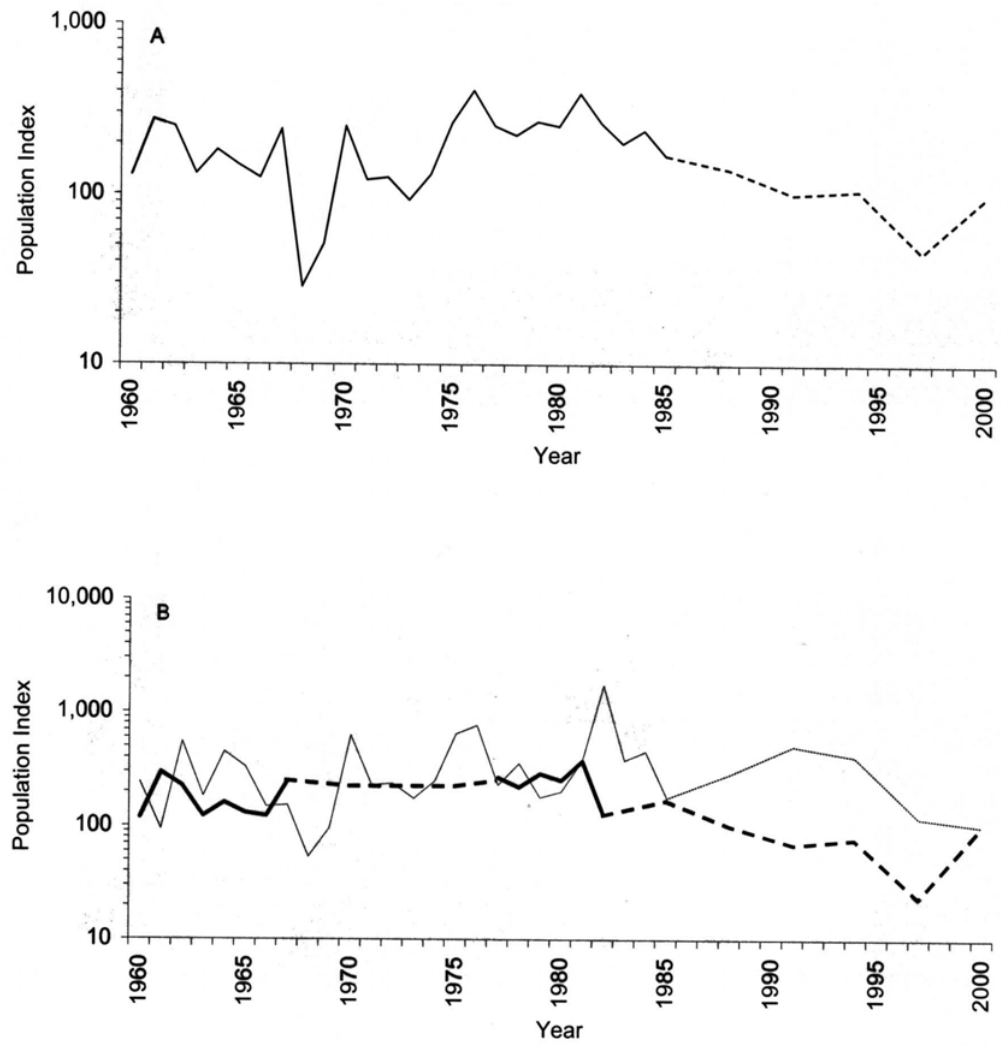


Figure 2

American coot population indices in Mexico, 1960-2000. Continuous lines connect surveys in consecutive years, dashed lines connect non-consecutive surveys. A) National population; B) Gulf of Mexico Coast (bold line), and Upper Pacific Coast (thin line).

Table 3

Population indices and numbers of American coot counted in Mexico. Indices indicate the relationship of the count in any given year to the latest count (year 2000). Counts were predicted from the TRIM model (see Methods) and do not represent absolute numbers of birds; indices are preferred as indicators of population change.

Year	Population index	Count	Year	Population index	Count
1960	129.97	314,369	1976	412.26	997,154
1961	274.32	663,496	1977	255.47	617,904
1962	250.83	606,700	1978	225.77	546,075
1963	132.35	320,124	1979	271.88	657,600
1964	182.55	441,541	1980	255.37	617,660
1965	149.46	361,510	1981	399.06	965,227
1966	125.84	304,366	1982	266.46	644,502
1967	242.63	586,863	1983	202.65	490,147
1968	28.63	69,257	1984	242.43	586,367
1969	51.20	123,842	1985	173.11	418,695
1970	253.16	612,326	1988	143.72	347,610
1971	122.49	296,262	1991	102.56	248,059
1972	126.57	306,145	1994	108.35	262,066
1973	93.17	225,345	1997	46.68	112,918
1974	132.54	320,579	2000	100	241,872
1975	265.99	643,347			

DISCUSSION

The most evident characteristic of American coot numbers in Mexico is the large year-to-year fluctuation (Figs. 2A, B). Large variations in numbers are common to migratory waterfowl in North America (see USFWS 2001) and indeed in Mexico, where such are the norm rather than the exception in most wintering populations (Pérez-Arteaga & Gaston, 2004). The negative relationship of American coot populations to drought conditions has been documented on the breeding grounds (Sutherland 1987, 1991), but it is unlikely that it constitutes a critical factor in coastal areas such as the main wintering areas in Mexico (Fig. 1).

No linear long-term trends were detected in the national population of American coot, but counts declined from 1981 until 1987 (Fig. 2A). This can be attributed to the downward long-term trend in the Gulf of Mexico coast (Table 2, Fig. 2B), which holds almost 80% of the national total (Table 2). There is no information to infer the cause of this decline, but it could be reflecting a broader (continental) trend. Even when no significant decline has been recorded in the main breeding grounds, some populations are particularly vulnerable due to increasing nesting habitat loss (Lang 1991). A shift in American coot wintering range has been recorded, with substantial declines in the Pacific flyway and increasing numbers in the Mississippi flyway, seemingly caused by

wetland destruction or drought in California (Alisauskas & Arnold 1994). North American waterfowl migrate to wintering grounds in Mexico mainly through the Pacific flyway (see Baldassarre 1994). The shift to wintering areas along the Mississippi flyway may be reflecting in decreasing numbers of American coot migrating to the Gulf Coast of Mexico through the Pacific flyway. However, more research is required to determine the causes of this decline. Also important is determining the extent of resident populations and the proportion that these constitute of the National total. This information will be useful to evaluate the relevance of Mexican wetlands for the continental population and to detect whether the decline in the Gulf of Mexico coast is caused by decreasing resident or migratory populations. Counts should preferably be conducted at annual intervals to assess large fluctuations between years and to produce more reliable estimates of population trends.

Those areas with the largest concentrations of American coot (Fig. 1), are also important to other waterfowl. Even though not designated, Tamesi and Pánuco river deltas, Ensenada Pabellón, Topolobampo, and Laguna Madre all qualify as Wetlands of International Importance under the Ramsar Convention (Pérez-Arteaga *et al.* 2002b). Tamesi and Pánuco river deltas hold more than 100,000 waterfowl; Ensenada Pabellón and Topolobampo hold more than 320,000 and 275,000 waterfowl respectively, and internationally important proportions of northern shoveler (*Anas clypeata*), northern pintail (*A. acuta*) and green-winged teal (*A. crecca*); Laguna Madre holds more than 290,000 waterfowl and internationally important concentrations of ruddy duck (*Oxyura jamaicensis*) and at least 32% of the world population of redhead (*Aythya americana*) (Pérez-Arteaga *et al.* 2002b). Possible threats for waterfowl in these areas include immoderate water extraction, modification of water fluxes, groundwater contamination (Campeche-Yucatán lagoons); water pollution from agricultural runoff, habitat destruction (Ensenada Pabellón, Topolobampo); pollution from oil industry and agriculture, habitat fragmentation and modification from cattle farming (Tabasco lagoons) (Arriaga-Cabrera *et al.* 2000). Extensive rice irrigation and shrimp farming has also been reported in the Upper Pacific coast in the state of Sinaloa, which may have negative impacts on local populations of wintering waterfowl (Ducks Unlimited 2001, see Paez-Osuna *et al.* 1998, Ruiz-Luna & Berlanga-Robles 1999, Hernandez-Cornejo & Ruiz-Luna 2000). In some areas of Laguna Madre, dredging and construction of permanent channels along the barrier islands have lowered salinity levels (Ducks Unlimited 2001), with sea grass abundance decreasing up to 60% (Mitchell *et al.* 1994).

In conclusion, based on the count data analysed here, there is no evidence to consider the overall population of American coot in Mexico as threatened, but declines in the Gulf Coast should be investigated. The reasons for this downward trend should be explored, and corrective measures should be taken. The size of resident populations in Mexico is unknown; calculating this figure is important to determine the relevance of Mexican wetlands to the continental population and whether species-specific conservation actions are required. Determining reproduction areas in Mexico is also of importance for developing conservation actions which can have an impact on the overall national population. American coot in Mexico are widespread, but large concentrations

occur in a few areas that are also of international importance for other waterfowl; to guarantee the long-term stability of American coot and other waterfowl in these areas, long-term conservation programs should be designed and implemented therein. International recognition (i.e. under the Ramsar Convention) for these sites should be sought to obtain attention and attract scarce conservation funds. The non-threatened status of the global American coot population should not prevent research and conservation efforts from being conducted; furthermore, the role of American coot as an indicator species should be investigated, as declines in the Gulf Coast of Mexico may be related to local habitat degradation.

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