Migratory waterbirds at artificial ponds in NW Tenerife (Canary Islands)

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Human settlements have mainly destroyed natural habitat but also led to the creation of new ones, some of them suitable for wildlife. In this line, the construction of artificial ponds for irrigation of agricultural land or on golf courses may also provide new habitats for waterbirds. Large freshwater wetlands are absent or very scarce on the Canary Islands, so both migratory and resident waterbirds usually use artificial water bodies as feeding or nesting sites. We compared monthly censuses over a period of ten years (2000–2009) in water bodies for agricultural irrigation and decorative pools on a nearby golf course on the Canary Islands and found differences in the number and species composition of waterbirds. We recorded a total of 51 migratory waterbird species. Average monthly abundance was fairly low in both sites, being higher in agricultural ponds (22.0 *vs.* 3.8 birds/monthly censuses), while overall species richness was slightly higher in the golf course (40 *vs.* 35 species). We suggest that these differences are related to the habitat features of both water body types. Waterbird abundance and diversity was higher during winter and passage months. Conserving, improving and managing correctly these sites could be of socio-economic interest for local people since some species observed are of conservation concern, and ornithological tourism is increasing.

Keywords: waterbirds, abundance, richness, irrigation ponds, golf course, islands.

1. Introduction

Human establishments are often associated with the destruction of natural habitats but also with creation of new ones that could be beneficial for birds (Bird *et al.* 1996; Terman 1997; Murgui 2009). Wetlands in particular have suffered great human pressure during the last decades and many of them have been destroyed (Gibbs 2000; Green *et al.* 2002; Mateo *et al.* 2007). Artificial aquatic habitats created by man, however, such as gravel pits, rice fields, salt pants or reservoirs, have nowadays become important alternative habitats for wild birds (Fasola & Ruiz 1996; Tourenq *et al.* 2001; Ma *et al.* 2004; Santoul *et al.* 2004). Furthermore, they gained crucial importance for the conservation of several threatened bird populations since natural habitat has been lost or degraded (Geslin *et al.* 2002; Nijman *et al.* 2008; Colding & Folke 2009).

Increased agriculture and tourist activities are the consequence of human occupation on many oceanic islands (Warnken *et al.* 2001; Apostolopoulos & Gayle 2002). Low and flat areas on the Canary Islands, for example, have been deeply transformed to intensively managed cultivations of banana or tomato (Otto *et al.* 2007), and many golf courses associated with tourist resorts have been created during the last years (Fernández-Palacios *et al.* 2004). As a consequence, large ponds have been constructed for irrigation since both intensively managed cultivations and golf courses depend on large amount of water. Natural wetlands have always been scarce in the western islands of the Canary archipelago, so these new habitats are now intensively utilized by both resident and migratory waterbirds as breeding or feeding sites (García-del-Rey 1999; Martín & Lorenzo 2001). In this sense, golf courses could be intensively used by waterbirds, in some cases being important for the conservation of threatened species when their natural habitat has already been destroyed (Terman 1997; Cristol & Rodewald 2005; Tanner & Gange 2005; White & Main 2005).

At the moment, a total of 16 waterbird species regularly or irregularly breed on the Canary Islands (Lorenzo 2007), while another 130 species (of a total of 322) have been observed during migration (Martín & Lorenzo 2001). Only a few quantitative studies describing seasonal variation of waterbird abundance and species composition have been carried out in this archipelago, the majority of them focused on coastal environments (Lorenzo 1993; Ramos *et al.* 1996; Fernández del Castillo 2002; Palacios 2004). Some of these studies have shown that some Canarian coastal sectors are of national significance for the wintering of several species (Lorenzo 1993; Ramos *et al.* 1996; Fernández del Castillo 2002).

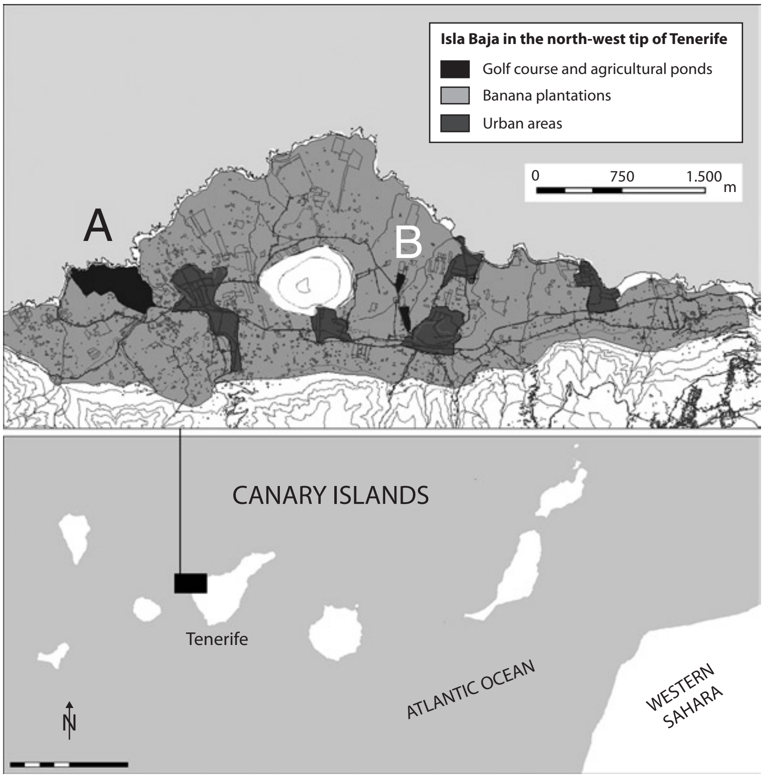

Figure 1: Location of the study area in the Isla Baja (North West Tenerife). The upper picture shows a detail of the landscape, including the golf course (A) and the irrigation ponds of the banana plantations (B). See details of each water reservoir in Table 1. – *Lage des Untersuchungsgebietes im Nordwesten Teneriffas. Die obere Abb. zeigt den enstprechenden Landschaftsausschnitt einschließlich des Golfplatzes (A) und die Bewässerungsteiche für die Bananenplantagen (B). Zu Einzelheiten jedes Gewässers s. Tab. 1.*

In this framework, we studied the status and phenology of waterbirds during the last ten years in two different types of artificial freshwater ponds (irrigation ponds for agriculture and decorative pools on a golf course). The objectives of this study were to describe the waterbird guilds using these artificial ponds, and to establish possible differences in terms of abundance and species richness. Finally, we recommend some management actions for these artificial sites, in order to enhance waterbird conservation and ornithological tourism.

2. Material and methods

2.1. Study area and species involved

This study was conducted in the Isla Baja in the north-west tip of Tenerife (Fig. 1), the largest island of the Canary Islands, located 330 km off the north-west African coast (27°37'–29°25'N and 13°20'–18°19'W). It is a coastal zone (from sea level to 185 m altitude) characterised by the presence of banana plantations and dispersed human settlements. Potential natural vegetation is almost inexistent and natural running water does not occur all year round. The coastline is characterised by rocky shores with small cliffs and boulder beaches. In 2002, a new golf course situated in Buenavista del Norte was inaugurated. Its small decorative pools (Fig. 2 A), and two of the largest water reservoirs for the irrigation of banana plantations located in Los Silos (Fig. 2 B), were selected to conduct migratory waterbird censuses by the facility of their access and due to the aggregation of the majority of migratory birds in the area (Rodríguez

Table 1: Characteristics of artificial ponds where counts were carried out between 2000 and 2009 in the north-west of Tenerife Island. – *Charakteristika der künstlichen Gewässer, die im Zeitraum 2000–2009 im Nordwesten Teneriffas untersucht wurden.*

Habitat – *Lebensraum*	Id	Water surface – *Wasserfläche* (ha)	Max. depth – *Maximale Tiefe* (m)	Water level variation – *Wassersstandsschwankung*	Mean shore inclination – *mittlere Uferneigung* (°)	Shore line lengh – *Uferlänge* (m)	Macrophytes – *Makrophyten*	Veget. shore – Anteil *Ufervegetation* (%)	Distance to the coast – *Entfernung zur Küste* (km)
Agriculture – *Agrarland*	1	0.49	4.00	yes	90	300	yes	0	1.4
	2	0.92	4.00	yes	90	395	yes	0	1.0
Golf course – *Golfplatz*	1	0.05	1	no	45	87	no	23	0.6
	2	0.01	0.75	no	45	35	no	2	0.6
	3	0.05	0.75	no	45	94	no	17	0.5
	4	0.03	0.50	no	45	70	no	11	0.4
	5	0.03	0.90	no	45	62	no	2	0.3
	6	0.12	3.60	no	45	128	no	32	0.3
	7	0.06	2.00	no	45	102	no	28	0.2

& RODRÍGUEZ 2006; pers. obs.). The agricultural ponds and golf course pools studied showed large abiotic and biotic differences (see Table 1).

We considered waterbird species included in the families Anatidae, Ardeidae, Ciconidae, Rallidae, Threskiornidae, Glareolidae, Recurvirostridae, Scolopacidae, Charadridae, Laridae and Sternidae. The Moorhen *Gallinula chloropus* and the Yellow-legged Gull *Larus michahellis atlantis* were excluded from the analysis since they are resident breeding species and show secretive behaviour (Moorhen) or are very common and widespread in the study area all year round (Yellow-legged Gull; pers. obs.). Furthermore, we excluded the following observations from our analyses: an individual of White Stork *Ciconia ciconia* and another of Blacksmith Lapwing *Vanellus armatus*, most likely escaped birds from captivity, a crake *Porzana* sp. in the agricultural ponds due to lacking identification, and domesticated and escaped ducks (*Cairinia moschata* and *Anas* sp.) present all year round in both study sites. The order and nomenclature of the species and family lists follow CLAVELL *et al*. (2005).

Figure 2: Aspects of the study sites where waterbird censuses were conducted in the Isla Baja (North West Tenerife, Canary Islands): (A) decorative pools of the Buenavista golf course, and (B) agricultural irrigation ponds of Los Silos. – *Ansichten des Untersuchungsgebietes für die Erfassung von Wasservögeln im Nordwesten Teneriffas: A) Zierteiche des Buenavista Golfplatzes, (B) Bewässe-rungsteiche von Los Silos.*

2.2. Waterbird counts

Censuses were carried out monthly from January 2000 to December 2009 in the agricultural water ponds and from January 2002 to December 2009 in the golf course. Censuses were missing in some months due to logistic limitations, but each month was characterised by using at least four different counts carried out in different years (96 and 57 censuses at agricultural ponds and golf pools, respectively; Table 2). Several visits per month were conducted at each pond type during migratory passage months in the Canarian archipelago (MARTÍN & LORENZO 2001) with the objective of detecting all passage species. We used the count with the highest number of individuals and species richness in our analyses when more than one count had been made in a given month. Due to its small numbers (Table 1), all the waterbirds in the ponds and its surroundings were counted by the stop and wait method (BIBBY *et al*. 2000; SANTOUL *et al*. 2004; SEBASTIÁN-GONZÁLEZ *et al*. 2010), using binoculars (10x) and a telescope (20–60x).

2.3. Data analysis

Data were grouped into agricultural ponds and golf course pools. The following parameters were defined: *Abundance* was calculated as birds/number of monthly censuses; *Richness* was the number of species observed; *Diversity* was expressed as the Shannon diversity index (KREBS 1999). Waterbirds guild overlap between agricultural and decorative golf ponds was measured using the percentage of each species through Pianka's index *O*, and varied between 0 (total separation) and 1 (total overlap). Bird abundance is an important factor characterising waterbird communities, but the low number of individuals detected did not allow a statistical analysis. The differences in the monthly number of species observed at each site were tested with Chi-squared tests.

Table 2: Number of censuses conducted during the study period in the north-west of Tenerife Island. – *Anzahl von Zählungen während Untersuchungsperiode im Nordwesten Teneriffas.*

Site – *Gebiet*	Period – *Periode*	Season – *Jahreszeit*			
		Winter – *Winter*	Spring – *Frühling*	Summer – *Sommer*	Autumn – *Herbst*
Agriculture – *Agrarland*	2000–2009	30	19	17	30
Golf course – *Golfplatz*	2002–2009	11	14	15	17

3. Results

3.1. General composition

A total of 51 species of waterbirds was recorded, representing 10 families and 28 genera (Annex 1). The most diverse families were Scolopacidae (20 spp.), Anatidae (12 spp.) and Ardeidae (7 spp.). Ten of these species, regularly or irregularly breed on the Canary Islands (Annex 1). Two of the species considered were recorded breeding in agricultural ponds during this study. One or two breeding pairs of Common Coot *Fulica atra* bred from 2001 until the end of the study period, and one successful breeding attempt of Little Ringed Plover *Charadrius dubius* occurred in 2005. The majority of the species sighted in this study (84 %) are considered as more or less regular migratory visitors to the Canaries, the rest being vagrants (Annex 1). Twenty-two species presenting unfavourable conservation status in Europe were recorded in this study, but all of them in low numbers (Annex 1). The most abundant species was the Common Coot *Fulica atra* (70.6 % of total individuals counted), followed by Greenshank *Tringa nebularia* (4.3 %), Common Sandpiper *Actitis hypoleucos* (3.6 %), Little Egret *Egretta garzetta* (3.2 %), Whimbrel *Numenius phaeopus* (3.2 %), Grey Heron *Ardea cinerea* (2.5 %) and Common Snipe *Gallinago gallinago* (2.4 %) (Fig. 3).

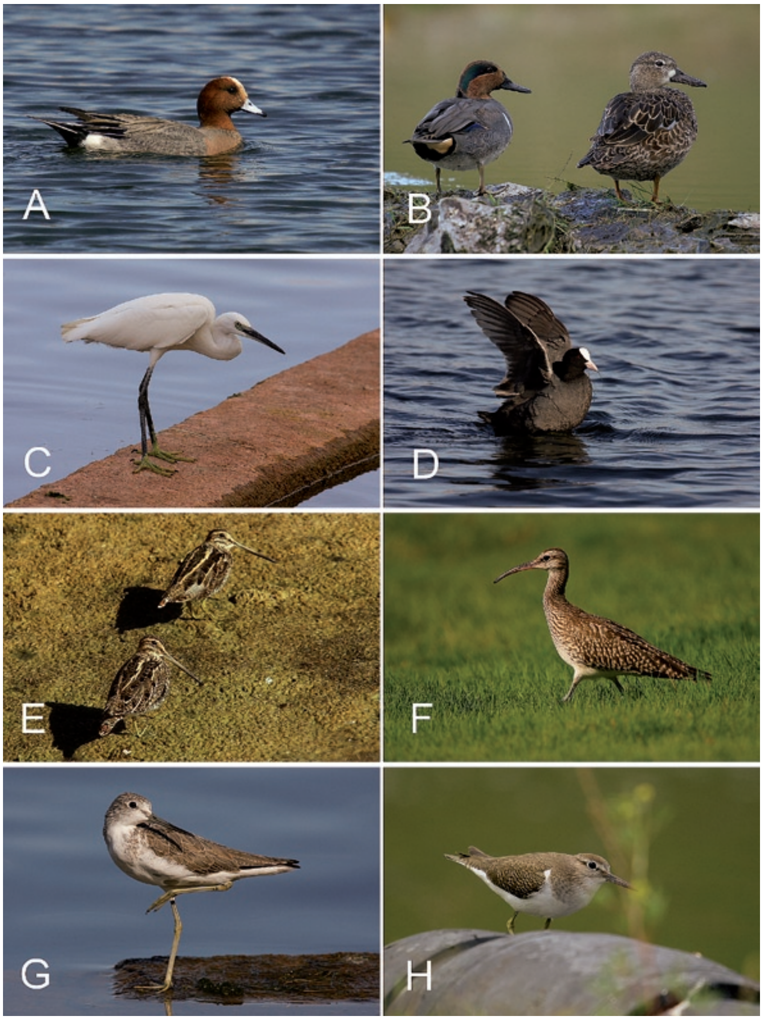

Figure 3: Representative waterbird species observed and photographed between 2000 and 2009 in the study sites: A) male Wigeon *Anas penelope*, B) male American Teal *Anas carolinensis* and female Blue-winged Teal *Anas discors*, C) Little Egrett *Egretta garzetta*, D) Common Coot *Fulica atra*, E) Common Snipe *Gallinago gallinago*, F) Whimbrel *Numenius phaeopus*, G) Greenshank *Tringa nebularia*, and H) Common Sandpiper *Actitis hypoleucos*. A, C, D, E, G were taken in the agricultural ponds and B, F, H, in the golf course. – *Typische Wasservogelarten, die zwischen 2000 und 2009 im Untersuchungsgebiet beobachtet und fotografiert wurden: A) Pfeifente* Anas penelope, *B) männliche Carolinakrickente* Anas carolinensis *und weibliche Blauflügelente* Anas discors, *C) Seidenreiher* Egretta garzetta, *D) Blessralle* Fulica atra, *E) Bekassine* Gallinago gallinago, *F) Regenbrachvogel* Numenius phaeopus, *G) Grünschenkel* Tringa nebularia *und H) Flussuferläufer* Actitis hypoleucos. *A, C, D, E, G wurden an den Bewässerungsteichen und B, F, H auf dem Golfplatz aufgenommen.*

3.2. Habitat variation

The waterbird guild in the agricultural water ponds was composed by 35 species included in eight families, while in the golf course 40 species belonging to 10 families were recorded during the present study (Annex 1). The Shannon diversity index was higher for the golf course than for the agricultural ponds (annual mean values 0.77 *vs.* 0.41), while the contrary pattern was observed in the average number of individuals, being higher in the agricultural ponds than in the golf course (annual mean values 22.0 *vs.* 3.8 birds/monthly censuses). The Pianka index shows very little overlap between both waterbird guilds (value 0.1). Ducks, herons and rails (represented only by the Common Coot) were more abundant in agricultural ponds than on the golf course, contrary to waders and gulls (Fig. 4). Species richness of ducks was higher in agricultural ponds than in the golf course pools, in opposite to the rest of the groups, which were more diverse in golf course (Fig. 4). A total of ten species was only recorded in the agricultural ponds, while a total of sixteen was exclusively observed in the golf course (Annex 1).

3.3. Temporal variation

In both sites, great variation in species richness and abundance of waterbirds was observed throughout the year (Fig. 5). Birds were more

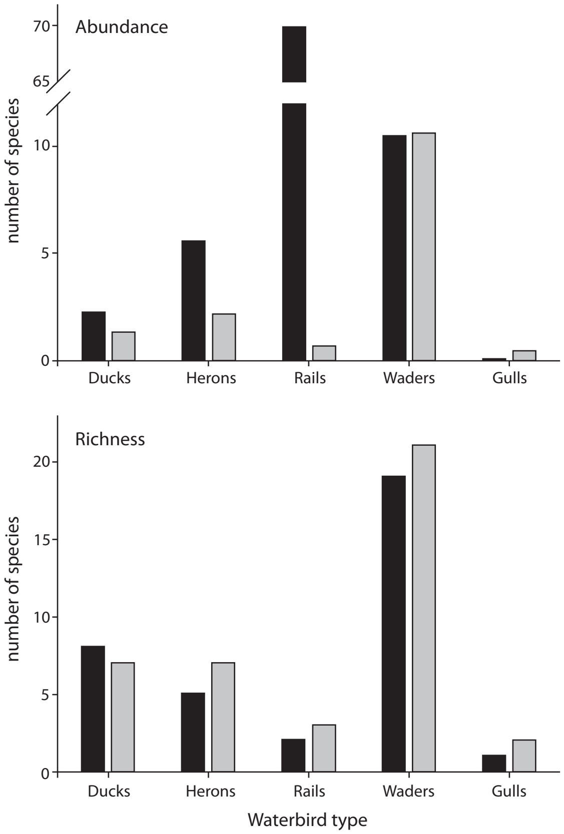

Figure 4: Global annual abundance (individuals/number of monthly censuses) and species richness of waterbird groups in the agricultural ponds (black bars) and golf course pools (grey bars) in the north-west of Tenerife between 2000 and 2009 (Ducks – family Anatidae; Herons – families Ardeidae and Threskiornidae; Rails – family Rallidae; Waders – families Recurvirostridae, Glareolidae, Charadriidae and Scolopacidae; Gulls – families Laridae and Sternidae). – *Häufigkeit (in Individuen/Anzahl monatlicher Zählungen) und Artenreichtum der Wasservogel-Gruppen an den Bewässerungsteichen (schwarze Säulen) und Zierteichen auf dem Golfplatz (graue Säulen) im Nordwesten Teneriffas 2000–2009 (Ducks = Entenvögel, Herons = Reiherartige, Rails = Rallen, Waders = Watvögel, Gulls = Möwen und Seschwalben).*

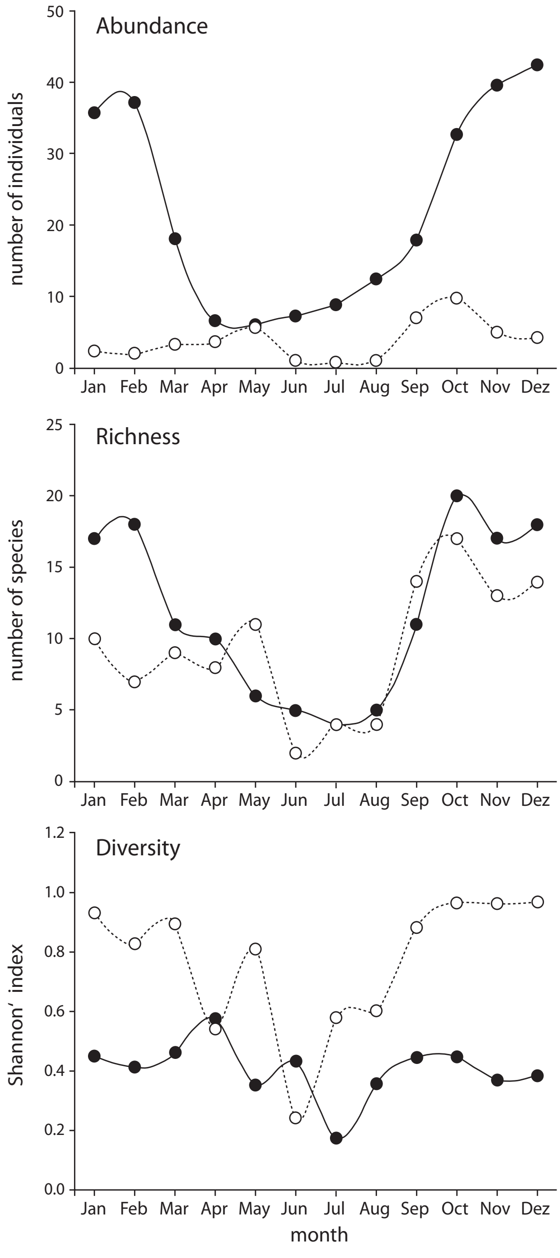

Figure 5: Seasonal variation of abundance (individuals/number of monthly censuses), species richness and diversity (Shannon diversity index) of waterbirds in the two artificial pond types in the north-west of Tenerife between 2000 and 2009 (black dots = agricultural ponds and white dots = golf course pools). – *Saisonale Variation von Abundanz (in Individuen pro Anzahl monatlicher Zählungen), Artenzahl und Diversität (Shannon-Index) von Wasservögeln an zwei Typen künstlicher Teiche im Nordwesten von Teneriffa von 2000 bis 2009 (schwarze Punkte = Bewässerungsteiche; weiße Punkte: Zierteiche auf dem Golfplatz).*

abundant during the end of summer to the beginning of spring in both sites, coinciding also with higher species richness (Fig. 5). The average number of months that each species was recorded in each site was higher in the agricultural ponds (4.2 months) than in golf course pools (2.8 months). Significant differences in the number of species were detected only in February, when the species richness was higher in the agricultural ponds than in the golf course pools ($\chi^2 = 6.25$; d. f. = 1; $p < 0.05$).

4. Discussion

According to our results only a low number of waterbirds use artificial ponds constructed for crop irrigation or the decoration of golf courses. Nevertheless, for some wader species they are of some importance for the total wintering population on the Canary Islands (Martín & Lorenzo 2001). Considering the number of species recorded in the present long-term monitoring and including four migratory species recorded before this survey (Night Heron *Nycticorax nycticorax* and three vagrant species, the Pied-billed Grebe *Podilymbus podiceps*, Greater Scaup *Aythya marila* and Lesser Yellowleg *Tringa flavipes*; Rodríguez & Rodríguez 2006; pers. obs.) the total number of species here reach 55. They represent 17.1 % of the total species recorded for the entire archipelago (Martín & Lorenzo 2001).

Tenerife Island is located more than 300 km off the African coast, where a migratory route of Western Palearctic birds exists (Newton 2008). The distance to the African coast is the reason why the migratory flow is more important in the eastern islands than in the western sector (Martín & Lorenzo 2001). The seasonal variation in richness and abundance in the present study agree with previous investigations. The majority of birds is present during the months between September and April, coinciding with the post-breeding and pre-breeding migratory movements and wintering (Lorenzo 1993; Ramos *et al.* 1996; Fernández del Castillo 2002; Palacios 2004).

Many studies have found ecological equivalence between natural and artificial wetlands (Fasola & Ruiz 1996; Elphick 2000; Tourenq *et al.* 2001; Ma *et al.* 2004; Santoul *et al.* 2004). Nevertheless, waterbirds assemblages of different sites in particular reflect specific preferences in feeding behaviour or breeding requirements (Bancroft *et al.* 2002; Paracuellos & Tellería 2004; Bellio *et al.* 2009). The ponds considered in this study are likely to attract any waterbird species that reach the island, but the slight differences found between the studied types of ponds (taking into account the large dataset from 2000–2010) may suggest some degree of habitat preferences. As previous studies have demonstrated, waterfowl and gallinules need water bodies with vegetated shores for feeding and breeding, while waders and herons need rather shallow waters and sparsely vegetated shores (Paracuellos 2006; Sánchez-Zapata *et al.* 2005; Raeside *et al.* 2007). Hence, it is possible that the higher species richness of golf course compared to agricultural ponds could be related with the higher structural richness of this habitat (vegetation cover and diversity of shore features).

Golf courses have been subjected of environmental debate since their constructions involves modification of natural habitats and a lot of water consumption (Warnken *et al.* 2001). However, they may have higher ecological value than green area habitats related to other land uses, and many of these sites also contribute to the preservation of fauna of conservation concern (Jones *et al.* 2005; Hodgkison *et al.* 2007; Colding & Folke 2009). The golf course pools studied by us presented vegetated shores and dense trees in the surroundings and may consequently have attracted more waterbirds than the bare concrete shores of agricultural ponds.

Human disturbance could play an important role in the changes of habitat use by birds (Hunter *et al.* 2001; Rodgers & Schwikert 2002; Beale & Monaghan 2004). Although the agricultural ponds censused in this study are in proximity to a paved road, usually birds are not noticed by local people since these ponds are protected by a wall. Unlike the agricultural ponds, the small dimensions of the golf course of Buenavista del Norte, and the consequent high level of human disturbance (presence of players and gardeners) could have influenced the time that birds spent at this site. Birds as highly mobile organisms might be observed in the golf course and stay some days there to move on later to the agricultural ponds, which are less disturbed by human presence. Since many species of waterbirds require different types of wetlands during their life cycle (Haig *et al.* 1998), our results could be biased: birds could move to other neighbour water reservoirs that were not considered in this study.

Another factor influencing the observed differences in waterbird assemblages could be the low density of macrophytes in the golf course pools, which are the food of some ducks and rails (Paracuellos & Tellería 2004). Indeed, it has been demonstrated that the abundance of herbivorous waterbirds and macrophytes could be strongly correlated (Yallop *et al.* 2004; Moreno-Ostos *et al.* 2007).

Several recommendations could be given to improve the quality of these two artificial habitats for waterbirds. Agricultural water ponds are relatively deep water bodies (>1 m) with vertical concrete shores. Two principal measures could improve their value for wildlife in general: 1) to make their margins shallower by infilling or include shallow margins (at least some parts) in their initial design to provide suitable conditions for emergent vegetation and other shallow-water plant species and associated fauna, and 2) to provide islands or rafts for nesting or resting waterbirds (Kushlan 1986; Ausden 2007). The latter method is very cheap and could be easily carried out in many agricultural ponds. The largest ponds should then be prioritized since they are likely to represent the most attractive ponds for birds (Paracuellos & Tellería 2004).

The construction of golf courses destroys natural habitats, which should be restored or compensated elsewhere bound by law (Hammond & Hudson 2007). General recommendations to facilitate the utilization of the golf course pools by waterbirds include: 1) increasing native vegetation within and surrounding pools and 2) reducing the amount of highly managed grass area, thus ensuring large undeveloped buffers to prevent disturbance to avian community (Ausden 2007; Hudson & Bird 2009). These measures could improve breeding and foraging habitats by supporting higher vegetation cover to place nests, increasing food (invertebrate) availability and limiting human disturbances

(Hudson & Bird 2009). Other factors to be considered are the periods when reparation or modifications works in both types of ponds need to be done. Early summer seems to be the ideal time frame for these activities because of the low abundance of waterbirds.

Finally, although numbers of waterbirds utilizing these environments in the Canary Islands are usually low, authorities, farmers and golf course managers should be informed of beneficial management practices in these sites for wildlife conservation, and also as an interesting resource for the increasing number of birdwatching tourists.

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5. Zusammenfassung

Rodríguez, B. & A. Rodríguez 2011: Durchziehende Wasservögel an künstlichen Gewässern im Nordwesten Teneriffas (Kanaren). Vogelwelt 132: 141 – 151.

Durch die menschliche Besiedlung wurden viele natürliche Lebensräume zerstört, aber auch neue geschaffen; einige bieten Wildtieren geeignete Lebensräume. In diesem Sinne können auch durch die Anlage von Bewässerungsteichen für landwirtschaftliche Kulturen und von Ziergewässern auf Golfplätzen neue Lebensräume für Wasservögel entstehen. Natürliche Feuchtgebiete fehlen auf den Kanarischen Inseln bzw. sind sehr selten. Deshalb besiedeln sowohl durchziehende als auch brütende Wasservögel in der Regel künstliche Gewässer als Nahrungs- oder Bruthabitate. Wir erfassten Wasservögel bei monatlichen Zählungen im Zeitraum von zehn Jahren (2000 bis 2009) an landwirtschaftlichen Bewässerungsteichen und an Zierteichen auf einem benachbarten Golfplatz auf Teneriffa und konnten deutliche Unterschiede in Artenzusammensetzung und Häufigkeit feststellen. Insgesamt beobachteten wir 51 Arten durchziehender Wasservögel. Die durchschnittliche Anzahl an Wasservögeln pro Monat war bei beiden Gewässertypen relativ niedrig, jedoch auf den Bewässerungsteichen deutlich höher (22,0 im Vergleich zu 3,8 Vögeln pro Monatszählung). Dagegen war die Artenzahl auf den Golfplatz-Zierteichen etwas höher (40 gegenüber 35 Arten). Diese Unterschiede dürften den unterschiedlichen Habitateigenschaften der Gewässertypen geschuldet sein. Abundanz und Diversität der Wasservögel waren während des Winters und der Zugzeiten höher als zur Brutzeit. Eine verbesserte Gestaltung und ein besseres Management der Gewässer unter naturschutzfachlichen Gesichtspunkten wären sinnvoll, da einige vorkommende Arten von erhöhtem Schutzinteresse sind und der Ornitho-Tourismus von wachsender sozioökonomischer Bedeutung ist.

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Annex 1: Origin, status [according to Martín & Lorenzo (2001) and BirdLife International (2004)], mean abundances (individuals/number of monthly counts) and percentage of occurrence combining all counts (%) of the migratory waterbirds observed during the present study (N = North America; E = Europe; A = Asia; Af = Africa; B = Breeding; W = Winter; P = Passage; R = Regular; I = Irregular; V = vagrant. * = species with unfavourable conservation status in Europe). – *Herkunft, Status (nach Martín & Lorenzo 2001 und BirdLife International 2004), mittlere Häufigkeit (in Individuen pro Anzahl monatlicher Zählungen) und Anteil an der Gesamtzahl (in %) von rastenden Wasservögeln, die im Rahmen dieser Untersuchung erfasst wurden (N = Nordamerika, E = Europa, A = Asien, Af = Afrika; B = Brutvogel, W = Wintergast; P = Durchzügler; R = regelmäßig; I = unregelmäßig; V = Irrgast. * = Arten mit ungünstigem Erhaltungszustand in Europa.*

Scientific name – *wiss. Artname*	Origin – *Herkunft*	Status – *Status*	Agricultural ponds – *Bewässerungsteiche*				Golf pools – *Zierteiche Golfplatz*				%
			Winter – *Winter*	Spring – *Frühling*	Summer – *Sommer*	Autumn – *Herbst*	Winter – *Winter*	Spring – *Frühling*	Summer – *Sommer*	Autumn – *Herbst*	
ANATIDAE											
Anas penelope	E	W (R), P (I)	0.17 ± 0.12	0	0	0.23 ± 0.06	0	0	0	0	0.6
Anas americana	N	V	0.07 ± 0.06	0	0	0.13 ± 0.12	0	0	0	0	0.2
*Anas strepera**	E	W (I)	0.07 ± 0.06	0	0	0.07 ± 0.06	0	0	0	0	0.1
Anas crecca	E	W (I)	0.30 ± 0.36	0	0	0.37 ± 0.29	0.14 ±0 .13	0	0	0.10 ±0.09	0.9
Anas carolinensis	N	V	0	0	0	0	0.14 ± 0.13	0	0	0.06 ± 0.10	0.1
*Anas acuta**	E	W (I)	0.07 ± 0.06	0	0	0.17 ± 0.06	0	0	0	0.10 ± 0.09	0.3
Anas discors	N	V	0	0	0	0	0.22 ± 0.05	0.04 ± 0.07	0	0.15 ± 0.01	0.3
*Anas clypeata**	E	W (I)	0	0	0	0	0.06 ± 0.10	0	0	0.10 ± 0.09	0.1
*Marmaronetta angustirostris**	E,A	B, P (I)	0	0	0	0	0	0	0.13 ± 0.13	0	0.1
*Aythya ferina**	E	W (I)	0	0	0	0.03 ± 0.06	0	0	0	0	< 0.1
Aythya collaris	N	V	0.13 ± 0.06	0.03 ± 0.06	0	0.07 ± 0.06	0	0	0	0	0.3
*Aythya fuligula**	E	W (I)	0.13 ± 0.12	0	0	0.20 ± 0.20	0	0	0	0.05 ± 0.08	0.4
ARDEIDAE											
*Ixobrychus minutus**	E	B, P (R)	0	0	0	0	0	0.07 ± 0.12	0	0	< 0.1
*Ardeola ralloides**	E	P (I)	0	0.10 ± 0.1	0	0	0	0.33 ± 0.25	0.05 ± 0.08	0	0.3
Bubulcus ibis	E	B, W (R)	0	0	0	0	0	0	0.10 ± 0.16	0.52 ± 0.68	0.5
Egretta garzetta	E	B, W (R)	0.57 ± 0.23	0.38 ± 0.32	1.19 ± 0.87	0.97 ± 0.06	0.08 ± 0.14	0	0.10 ± 0.16	0.44 ± 0.23	3.2
Casmerodius albus	E ,N	V	0.07 ± 0.06	0	0	0.03 ± 0.06	0	0	0	0	0.1
Ardea cinerea	E	B, W (R)	1.00 ± 0.62	0.30 ± 0.26	0.16 ± 0.15	0.73 ± 0.29	0.08 ± 0.14	0.11 ± 0.10	0.10 ± 0.16	0.10 ± 0.09	2.5
*Ardea purpurea**	E	P (R)	0	0	0	0	0	0.04 ± 0.07	0	0	< 0.1
THRESKIORNITHIDAE											
*Plegadis falcinellus**	E, Af	W (I), P (I)	0	0	0	0.07 ± 0.06	0	0	0	0.05 ± 0.08	0.1
RALLIDAE											
Porzana porzana	E	P (I)	0	0	0	0.03 ± 0.06	0.08 ± 0.14	0	0.05 ± 0.08	0.14 ± 0.14	0.3
Fulica atra	E	B, W (R)	23.57 ± 8.94	4.67 ± 0.42	10.28 ± 2.82	31.27 ± 4.86	0	0	0	0.38 ± 0.66	70.6
RECURVIROSTRIDAE											
Himantopus himantopus	E	B, P (R)	0	0.12 ± 0.13	0	0	0.25 ± 0.43	0	0	0	0.2

GLAREOLIDAE										
*Glareola pranticola**	E	P(R)	0	0	0	0	0	0.07 ± 0.12	0	0	< 0.1
CHARADRIIDAE										
Charadrius dubius	E	B, W (R)	0.3±0.3	0.37 ± 0.55	0.27 ± 0.23	0.33 ± 0.05	0	0.04 ± 0.07	0	0	1.2
Charadrius hiaticula	E	W (R), P (R)	0	0	0	0.07 ± 0.12	0	0.07 ± 0.12	0.18 ± 0.16	0	0.2
Pluvialis apricaria	E	W (I), P (I)	0	0.08 ± 0.14	0	0	0	0	0.05 ± 0.08	0	0.1
*Vanellus vanellus**	E	W (R), P (R)	0	0	0	0	0.06 ± 0.10	0	0	0.10 ± 0.09	0.2
SCOLOPACIDAE										
Calidris alba	E	W (R), P(R)	0	0	0.10 ± 0.06	0	0	0	0.05 ± 0.08	0	0.1
Calidris minuta	E	W (R), P (R)	0	0	0.05 ± 0.08	0	0	0	0	0	< 0.1
Calidris temminckii	N	W (I), P (I)	0	0	0	0.03 ± 0.06	0	0	0	0	< 0.1
Calidris fuscicollis	N	V	0	0	0	0.07 ± 0.12	0	0	0	0.10 ± 0.16	0.1
Calidris melanotos	N	V	0	0	0.10 ± 0.16	0.07 ± 0.12	0	0	0.05 ± 0.08	0	0.2
Calidris ferruginea	E	W (I), P (I)	0	0	0	0.03 ± 0.06	0	0	0.05 ± 0.08	0.05 ± 0.08	0.1
*Calidris alpina**	E	W(R), P (R)	0	0.07 ± 0.12	0.10 ± 0.16	0	0.14 ± 0.13	0.97 ± 1.27	0.23 ± 0.22	0.06 ± 0.10	1.1
*Philomachus pugnax**	E	W (R), P (R)	0	0	0	0	0.08 ± 0.14	0	0.14 ± 0.25	0.05 ± 0.08	0.2
*Lymnocryptes minimus**	E	W (I), P (I)	0.03±0.06	0	0	0.07 ± 0.12	0	0	0	0	0.1
*Gallinago gallinago**	E	W (R), P (R)	0.93±0.74	0	0.05 ± 0.08	0.47 ± 0.35	0.28 ± 0.25	0	0	0.48 ± 0.28	2.4
*Scolopax rusticola**	E	B, P (R)	0	0	0	0	0	0	0.08 ± 0.14	0	< 0.1
*Limosa limosa**	E	W (R), P(R)	0.03±0.06	0	0	0.03 ± 0.06	0.14 ± 0.13	0	0	0	0.1
Limosa lapponica	E	W (R), P (R)	0	0	0	0	0	0.11 ± 0.10	0	0.06 ± 0.10	0.1
Numenius phaeopus	E	W (R), P (R)	0	0	0	0	0.39 ± 0.32	1.38 ± 0.88	0.90 ± 1.57	1.71 ± 1.14	3.2
*Tringa totanus**	E	W (R), P (R)	0.03±0.06	0	0.05 ± 0.08	0.03 ± 0.06	0	0.07 ± 0.12	0	0.05 ± 0.08	0.2
Tringa nebularia	E	W(R), P (R)	1.90±0.10	0.30 ± 0.52	0.18 ± 0.20	1.40 ± 0.36	0.08 ± 0.14	0	0.05 ± 0.08	0.05 ± 0.08	4.3
Tringa ochropus	E	W (R), P (R)	0.20±0.10	0	0	0.27 ± 0.21	0	0	0	0	0.6
*Tringa glareola**	E	W (I), P (I)	0.03±0.06	0.07 ± 0.12	0	0	0	0	0	0	0.1
*Actitis hypoleucos**	E	W (R), P (R)	0.5±0.21	0.13 ± 0.12	0.51 ± 0.58	0.93 ± 0.25	0.31 ± 0.34	0	0.48 ± 0.82	1.21 ± 0.31	3.6
Phalaropus tricolor	N	V	0	0	0	0	0	0	0	0.05 ± 0.08	< 0.1
LARIDAE										
Larus ridibundus	E	W (R), P (R)	0	0	0	0.03 ± 0.06	0	0	0.14 ± 0.14	0.05 ± 0.08	0.2
Larus fuscus	E	B, W (R)	0	0	0	0	0	0.07 ± 0.12	0	0.10 ± 0.09	0.1
STERNIDAE										
*Chlidonias hybrida**	E	W (I), P (I)	0	0	0	0	0	0.07 ± 0.12	0	0	< 0.1