# Waterbirds general

## Table of Contents

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### Waterbirds general 2016

Cherkaoui, S. I., N. Magri, and S. Hanane. 2016. Factors Predicting Ramsar Site Occupancy by Threatened Waterfowl: The Case of the Marbled Teal *Marmaronetta angustirostris* and Ferruginous Duck *Aythya nyroca* in Morocco. *Ardeola* **63**:295-309.

(Abstract)

Since 2005, Morocco has designated many Ramsar wetlands, yet little is known about factors determining their occupation by waterbird communities. In this study, we assessed the relationship between the occupation of Moroccan Ramsar wetlands during the breeding season by two globally threatened waterbirds, the marbled teal *Marmaronetta angustirostris*and the ferruginous duck *Aythya nyroca*, and geographical, topographical and macrohabitat factors. Habitat-based statistical models showed that the presence of these two threatened waterfowl species at Moroccan wetlands was positively correlated with the number of emergent vegetation species, and negatively correlated with altitude and the distance to the nearest coastline. These results highlighted previous findings regarding the significant and positive relationship between the number of plant taxa and the number of threatened waterbird species at Moroccan wetlands. Further investigations should be conducted at regional (Maghreb region) and international (Mediterranean area) levels (i) to allow a global analysis and benchmarking between regions, (ii) to improve the provision of information to support sound management interventions, and (iii) to contribute to conservation management planning for these threatened waterfowl species.

Yang, P., X. Liu, and B. Xu. 2016. Spatiotemporal pattern of bird habitats in the Poyang Lake based on Landsat images. *Environmental Earth Sciences* **75**:1230.

(Abstract)

The Poyang Lake is the largest freshwater lake in China and possesses unique wetland and plentiful biological resources. Because of the dual influence of the Five Rivers and Yangtze River, the water level of Poyang Lake changes seasonally, which has important influence on the local ecosystem. A better knowledge of the spatiotemporal pattern of water body and bird habitats is important for bird diversity conservation and wetland management. In this study, we collected six Landsat images in both winter and summer seasons from 1995 to 2009. These images were processed in both ERDAS Imagine 9.1 and ArcGIS 9.3 by image registration, geometric rectification and classification based on image characteristics and field survey data. The bird habitats in Poyang Lake wetland were classified into six types as shoal water, middle-depth water, deep water, grassland, sand land and mudflat. The results showed: (1) In winter seasons, grassland, mudflat and shoal water were the three main bird habitats in winter (totally around 70 %); water body area increased 13.6 % from 1995 to 1999 and then

decreased 11.8 % from 1999 to 2007, and the mudflat decreased all the time from 1995 to 2007. (2) In summer seasons, water area occupied more than 60 % of the whole area; due to high water level, most plants were submerged and not suitable for bird feeding; shoal water area and grasslands were the two main bird habitats in summer. Compared with changes in summer seasons, all bird habitats changed obviously in winter seasons. Based on our research, we suggests that it is important to monitor the change in water level, area of water body, area of grassland and mudflat in future research by incorporating related precipitation data, water station record, multispectral and multi-temporal remote sensing images in the Poyang Lake since these habitats are key for migrating birds.

Xia, S., Y. Liua, Y. Wang, B. Chen, Y. Jia, G. Liu, X. Yu, and L. Wen. 2016. Wintering waterbirds in a large river floodplain: Hydrological connectivity is the key for reconciling development and conservation. *Science of the Total Environment* **573**:645–660.

(Abstract)

An alteration in the hydrological connectivity reduces the synergistic processes and interactions between rivers and their floodplains, and changes the distribution of waterbirds that rely on floodplains as foraging grounds. Recent river and wetland conservation and restoration efforts have been partially focused on reinstating the natural river–floodplain connectivity to ameliorate the ecological effects of regulation in river systems. However, in regions where human well-being is tightly linked with the cultivation of the floodplain (such as fisheries), management options are constrained and trade-offs among competing social, economic and ecological goals may be necessary for the wise use of wetlands. Poyang Lake in east central China includes numerous sub-lakes with different types of hydrological regulation; therefore, this lake may provide a useful context for exploring the likelihood of such trade-offs. In this study, we used multiyear simultaneous waterbird survey data together with habitat maps derived from satellite imagery for Poyang Lake to examine the variations in waterbird community structure and abundance within sub-lakes with different types of hydrological regulation. Using a Bayesian Markov chain Monte Carlo approach, we built generalized linear mixed models to explore the differences in wetland composition and waterbird abundance/diversity among three lake types (i.e. isolated, freely connected, and controlled) at community, guild and species levels. The results showed hydrological connectivity alteration clearly affects wintering waterbirds; in addition, the ecological benefits of a natural flow regime were most unambiguous at the community level. Nevertheless, little evidence exists to indicate that the lakes' ecological values as waterbird foraging grounds were compromised by partial regulation. That is, species richness and population size were comparable in naturally connected and controlled lakes. Our results suggest that, with carefully designed management plans, a delicate balance between waterbird conservation and development can be accomplished in large river floodplains.

Hartman, C. A., J. T. Ackerman, and M. P. Herzog. 2016. Island Characteristics Within Wetlands Influence Waterbird Nest Success and Abundance. *The Journal of Wildlife Management* **80**:1177–1188.

(Abstract)

Coastal waterbird populations are threatened by habitat loss and degradation from urban and agricultural development and forecasted sea level rise associated with climate change. Remaining wetlands often must be managed to ensure that waterbird habitat needs, and other ecosystem functions, are met. For many waterbirds, the availability of island nesting habitat is important for conserving breeding populations. We used linear mixed models to investigate the influence of pond and island landscape characteristics on nest abundance and nest success of American avocets (*Recurvirostra americana*), black-necked stilts (*Himantopus mexicanus*), and Forster's terns (*Sterna forsteri*) in San Francisco Bay, California, USA, based on a 9-year dataset that included >9,000 nests. Nest abundance and nest success were greatest within ponds and on individual islands located either 4 km from San Francisco Bay. Further, nest abundance was greater within ponds with relatively few islands, and on linear-shaped, highly elongated islands compared to more rounded islands. Nest success was greater on islands located away from the nearest surrounding pond levee. Compared to more rounded islands, linear islands contained more near-water habitat preferred by many nesting waterbirds. Islands located away from pond levees may provide greater protection from terrestrial egg and chick predators. Our results indicate that creating and maintaining a few, relatively small, highly elongated and narrow islands away from mainland levees, in as many wetland ponds as possible would be effective at providing waterbirds with preferred nesting habitat.

Hartman, C. A., J. T. Ackerman, J. Y. Takekawa, and M. P. Herzog. 2016. Waterbird Nest-Site Selection is Influenced by Neighboring Nests and Island Topography. *The Journal of Wildlife Management* **80**:1267–1279.

(Abstract)

Avian nest-site selection is influenced by factors operating across multiple spatial scales. Identifying preferred physical characteristics (e.g., topography, vegetation structure) can inform managers to improve nesting habitat suitability. However, social factors (e.g., attraction, territoriality, competition) can complicate understanding physical characteristics preferred by nesting birds. We simultaneously evaluated the physical characteristics and social factors influencing selection of island nest sites by colonial-nesting American avocets (*Recurvirostra americana*) and Forster's terns (*Sterna forsteri*) at 2 spatial scales in San Francisco Bay, 2011–2012. At the larger island plot (1m2) scale, we used real-time kinematics to produce detailed topographies of nesting islands and map the distribution of nests. Nesting probability was greatest in island plots between 0.5m and 1.5m above the water surface, at distances 10m from the water's edge, and of moderately steep (avocets) or flat (terns) slopes. Further, avocet

and tern nesting probability increased as the number of nests initiated in adjacent plots increased up to a peak of 11–12 tern nests, and then decreased thereafter. Yet, avocets were less likely to nest in plots adjacent to plots with nesting avocets, suggesting an influence of intra-specific territoriality. At the smaller microhabitat scale, or the area immediately surrounding the nest, we compared topography, vegetation, and distance to nearest nest between nest sites and paired random sites. Topography had little influence on selection of the nest microhabitat. Instead, nest sites were more likely to have vegetation present, and greater cover, than random sites. Finally, avocet, and to a lesser extent tern, nest sites were closer to other active conspecific or heterospecific nests than random sites, indicating that social attraction played a role in selection of nest microhabitat. Our results demonstrate key differences in nest-site selection between co-occurring avocets and terns, and indicate the effects of physical characteristics and social factors on selection of nesting habitat are dependent on the spatial scale examined. Moreover, these results indicate that islands with abundant area between 0.5m and 1.5m above the water surface, within 10m of the water's edge, and containing a mosaic of slopes ranging from flat to moderately steep would provide preferred nesting habitat for avocets and terns.

Kingsford, R. T., A. Basset, and L. Jackson. 2016. Wetlands: conservation's poor cousins. *Aquatic Conservation: Marine and Freshwater Ecosystems* **26**:892-916.

(Abstract)

1. About 5–10% of the world's land surface is currently wetland but possibly >70% is already destroyed or impaired. Conservation of these unique ecosystems lags progress in other realms, reflected in high rates of biodiversity loss. Wetlands provide a range of critically important ecosystem services including fresh water, nutrient cycling, food and fibre production, carbon fixation and storage, flood mitigation and water storage; water treatment and purification and habitats for biodiversity. There is increasing recognition that these services provide real economic values.
2. Wetlands are affected by numerous threats including habitat loss and degradation, climate change, pollution, invasive species, overharvesting and disease. The most serious impact is from habitat loss and degradation caused by upstream water resource developments and conversion to agriculture, industry and transport, and urban development.
3. The status of the distribution and extent of the world's wetlands remains poorly known, varying among countries. Wetland loss has varied internationally, with generally higher impacts in the Northern Hemisphere, with its long history of conversion to urban centres, ports and agriculture and yet there are increasing losses occurring in developing continents in the south.
4. Wetland conservation needs to focus primarily on identification of priority areas for biodiversity conservation and legal protection, including Ramsar-listing. Identification of wetland biodiversity hotspots for conservation should be an imperative, with associated Ramsar-listing. There also needs to be effective protection of flow regimes. Mitigation of other deleterious processes, pollution, overharvesting, invasive species and disease, also remains

particularly important.
5. Conservation of wetlands remains especially challenging, given the importance of fresh water for human communities, industry and agriculture. Without effective conservation actions, mitigation of threats, rigorous risk assessment and acknowledgement of the value of wetland ecosystem services, wetland conservation will continue to lag behind conservation in other realms in protecting the Earth's biodiversity.

Dronova, I., S. R. Beissinger, J. W. Burnham, and P. Gong. 2016. Landscape-level Associations of Wintering Waterbird Diversity and Abundance from Remotely Sensed Wetland Characteristics of Poyang Lake. *Remote Sensing* **8**:462.

(Abstract)

Poyang Lake, the largest freshwater wetland in China, provides critical habitat for wintering waterbirds from the East Asian Flyway; however, landscape drivers of non-uniform bird diversity and abundance are not yet well understood. Using a winter 2006 waterbird survey, we examined the relationships among metrics of bird community diversity and abundance and landscape characteristics of 51 wetland sub-lakes derived by an object-based classification of Landsat satellite data. Relative importance of predictors and their sets was assessed using information-theoretic model selection and the Akaike Information Criterion. Ordinary least squares regression models were diagnosed and corrected for spatial autocorrelation using spatial autoregressive lag and error models. The strongest and most consistent landscape predictors included Normalized Difference Vegetation Index for mudflat (negative effect) and emergent grassland (positive effect), total sub-lake area (positive effect), and proportion of submerged vegetation (negative effect). Significant spatial autocorrelation in linear regression was associated with local clustering of response and predictor variables, and should be further explored for selection of wetland sampling units and management of protected areas. Overall, results corroborate the utility of remote sensing to elucidate potential indicators of waterbird diversity that complement logistically challenging ground observations and offer new hypotheses on factors underlying community distributions.

Martínez-Abraín, A., J. Jiménez, J. A. Gómez, and D. Oro. 2016. Differential Waterbird Population Dynamics after Long-term Protection: The Influence of Diet and Habitat Type. *Ardeola* **63**:5-27.

(Abstract)

Using as a model system a long-term data set (1984-2014) of waterbird counts at nine large wetlands of Eastern Spain (Comunidad Valenciana), we explored the ecological drivers of population fluctuations, both during the wintering (34 species) and breeding (36 species)

seasons. Most species showed increasing trends (80% during breeding, 62% in winter), including both initially common and rare species, suggesting a positive effect of site protection policies that were mainly applied in the 1980s. Specialised freshwater species such as diving ducks and coots did not show population recovery, most probably due to the characteristic tendency of shallow lagoons to remain eutrophic even after several decades of the implementation of sewage management and water purification. In fact re-introduction of a diet-specialist (red-knobbed coot) failed but that of a diet-generalist (purple swamphen) succeeded. Waterfowl hunting and the abandonment of rural practices also probably played a role in the lack of recovery by some species. Population trends of breeding species were more dependent on local conditions than trends of wintering populations. Body size could also have some influence on growth rates because some of the smallest species of shorebirds and Laridae (such as Kentish plovers, little terns and black-headed gulls) showed decreasing trends in one or both seasons. Finally, a few species were gained for the system as new wintering species, probably due to climate warming. Our results suggest that growth rates alone are poor descriptors of population fluctuations, especially for birds and other vagile taxa, and that it is more appropriate to interpret trends when considering natural regions spatially, and when growth rates are analysed within the time scale of the theoretical logistic curve.

Lehikoinen, A., J. Rintala, E. Lammi, and H. Pöysä. 2016. Habitat-specific population trajectories in boreal waterbirds: alarming trends and bioindicators for wetlands. *Animal Conservation* **19**:88–95.

(Abstract)

Identification of conservation priorities is a fundamental issue for successful nature conservation. This can be done by looking at population trends of species in different habitats. Boreal zone is the key breeding area for many Eurasian waterbirds. Wetlands of the boreal zone can be roughly classified into two different groups: nutrient-poor oligotrophic and nutrient-rich eutrophic water ecosystems. Earlier work has shown that eutrophic lake-specialist species have declined compared with generalists and species preferring oligotrophic lakes. However, it is not known if species that live in both habitats show habitat-specific population trends. We used monitoring data of breeding waterbirds in Finland from 1986 to 2013 to evaluate habitat-specific population trends in five generalist duck species, which mostly overwinter in the coastal waters of West Europe. Population trend of tufted duck was highly significantly more positive in oligotrophic wetlands compared with populations in eutrophic wetlands, and two other species had similar but weaker effects. In addition, we established bird population state indicators for oligotrophic and eutrophic water ecosystems in Finland. The indicators revealed that the populations in eutrophic wetlands have on average halved since early 1990s. The populations in oligotrophic wetlands have remained stable, except a moderate decline since the late 2000s. Our findings support the idea that the waterbird populations of the eutrophic wetlands are in serious trouble. This is likely due to over-eutrophication of these ecosystems. Conservation and management actions should be urgently taken to halt the loss of biodiversity in these globally threatened freshwater ecosystems.

Guan, L., Y. Jia, N. Saintilan, Y. Wang, G. Liu, G. Lei, and L. Wen. 2016. Causality between abundance and diversity is weak for wintering migratory waterbirds. *Freshwater Biology* **61**:206–218.

(Abstract)

1. The species–area relationship, which is closely linked with the more general species-energy theory, is one of the most well-known patterns in geographical ecology, but the underlying causes remain contentious. The more individuals hypothesis (MIH) articulates a causal path from resource availability to population abundance to species richness. The MIH has been tested with a range of taxa including plants, invertebrates and land birds but never with migratory waterbirds.

2. Using multiyear simultaneous survey data of wintering waterbirds in 10 lakes at Poyang Lake, China, and remotely sensed habitat condition measurements, we applied structural equation modelling (SEM) to test three causal paths: (A) good habitat conditions (e.g. habitat availability and heterogeneity) attract more species (high richness); (B) habitat conditions promote abundance (more individuals); and (C) habitat conditions promote abundance, which in turn increases richness.

3. We also modelled responses of species richness and abundance to habitat conditions using generalised additive mixed modelling (GAMM) to assess their co-variation.

4. While our analysis confirmed the first two paths, we found no support for the third, which is the central postulate of the MIH. In addition, in agreement with GAMM, SEM indicated that species richness was more closely related to habitat quality than to abundance. Our findings suggest that wintering waterbird species richness and abundance are two intrinsic community indices that covary with environmental variables.

Zou, Y.-A., C.-D. Tang, J.-Y. Niu, T.-H. Wang, Y.-H. Xie, and H. Guo. 2016. Migratory Waterbirds Response to Coastal Habitat Changes: Conservation Implications from Long-term Detection in the Chongming Dongtan Wetlands, China. *Estuaries and Coasts* **39**:273–286.

(Abstract)

Changes in waterbird populations in relation to changes in their habitat are of great concern in the Chongming Dongtan wetlands, one of the most important stopovers for migrating waterbirds in the East Asian–Australasian Flyway. We analyzed the relationship between the changes in the dominant waterbird populations (*Charadriidae*, *Anatidae*, *Ardeidae*,

and *Laridae*) and the changes in their corresponding habitats from 2000 to 2012. In natural wetlands, the species number of *Anatidae* was significantly positively correlated with the *Scirpus mariqueter* (hereafter *Scirpus*) habitat but significantly negatively correlated with the *Phragmites australis* (hereafter *Phragmites*) habitat. The densities of *Charadriidae* and *Laridae* were both significantly positively correlated with the deep water habitat but significantly negatively correlated with the *Spartina alterniflora* (hereafter *Spartina*) habitat. The density of *Charadriidae*, however, also exhibited significantly positive correlation with the *Scirpus* habitat. In the aquaculture ponds, the changes in the density of *Anatidae* in the winter were significantly negatively correlated with the changes in aquaculture ponds. Other waterbirds only exhibited positive or negative correlation trends with their habitats, which did not reach the statistically significant levels. Consequently, changes in waterbird populations are significantly correlated with changes in natural wetlands and aquaculture ponds in the Chongming Dongtan wetlands. Natural wetlands and aquaculture ponds are important to migratory waterbirds during the peak of migration and wintering. Our results promote the development of wetland management strategies for protecting migratory waterbirds in the coastal area of the Yangtze River.

## Waterbirds general 2015

Harebottle, D. M., and L. G. Underhill. 2015. Assessing the value of wetlands to waterbirds: exploring a population-based index at flyway and regional levels. *Ostrich* **87**:7-21.

(Abstract)

Traditionally, species richness, species diversity, total count, biomass, energy consumption and the Ramsar ‘1% threshold’ have been used to assess the importance of wetlands for waterbirds. Designation of wetlands of international importance (Ramsar sites) based on waterbirds has focused on those species meeting the Ramsar 1% population threshold levels. These levels prioritise a subset of species as being important, with little or no consideration to the contributions of the remaining species’ populations. In this paper, we evaluate and further describe a quantitative method to assess wetland avifaunal importance. Termed the Waterbird Conservation Value (WCV), this index sums the ratio of each species’ abundance to its published 1% threshold across all species to give an overall measure of the ‘value’ of the waterbirds at a wetland. Large values indicate that large proportions of the total populations of waterbird species are present at the wetland. Indices can be evaluated at site and species levels. The WCV is a more nuanced approach, sensitive to actual species’ abundance rather than counts of ‘1% threshold’ species and considers all species in the assessment. The outputs of the WCV index are demonstrated and discussed using a case study from three regions within the East Atlantic flyway.

Elphick, C. S. 2015. A history of ecological studies of birds in rice fields. *Journal of Ornithology* **156**:S239–S245.

(Abstract)

Birds have been studied in rice fields for over a century. Early studies focused on species directly linked to crop production, either because they were considered to be crop pests or because they preyed upon undesirable species found in fields. Prior to 1970, most studies focused on waterfowl, with a majority coming from North America. This taxonomic and geographic bias persisted into the 1980s, when research began to diversify along multiple axes. Work on birds in rice fields has expanded on all continents, but is dominated by studies from Asia, Europe, and North America. Although Asian studies have become more numerous, they remain substantially fewer than expected given the geographic distribution of rice production. Studies from Africa are also less common than expected on the basis of the area of rice grown. Taxonomically, studies of large wading birds are now most numerous, although waterfowl research remains common. Studies of other taxonomic groups have also increased, as has research that examines the avian community more broadly by considering birds from multiple taxonomic groups. Landbird studies peaked in the 1990s with a focus on controlling crop depredation, but remain rare otherwise. Most research remains centered on waterbirds, despite evidence of rice field use by a diversity of passerines, raptors, and other landbirds. Research also has been dominated by descriptive studies, usually with an applied focus. Ornithologists, however, are beginning to recognize the high potential of rice field systems for conducting more experimental studies and for testing a wider variety of basic ecological questions.

Sui, X., L. Chen, A. Chen, D. Wang, W. Wang, H. Ge, and G. Ji. 2015. Assessment of temporal and spatial landscape and avifauna changes in the Yellow River wetland natural reserves in 1990–2013, China. *Ecological Engineering* **84**:520–531.

(Abstract)

Riverine wetlands provide important habitats and travel corridors for resident and transient species, playing a key role in maintaining the diversity of entire landscapes. This paper assessed a long-term (1990–2013) landscape changes and avifauna community dynamics in the Yellow River wetland natural reserves, China. Remote sensing information was combined with field surveys to collect critical data on land use and avifaunal populations. The results reveal that land use has dramatic changes during 1990–2013. Utilized water features have significantly decreased over 20 years, whereas artificial land features such as paddy, dry field and built-up area have shown a steady increasing trend in the three riverine wetlands. The spatial landscape patterns of the three wetlands have become fragmented and notably heterogeneous as results of rapid economic development. With the changes of utilized water features, avifauna data show that some overwintering and transient species are becoming permanent residents. Though there is an abundant and diverse array of bird species utilizing

the wetlands, migrating traits of these avifauna species have changed. This study can provide basic information for making effective and sustainable conservation plans for the entire Yellow River wetland natural reserves.

Dybala, K. E., M. L. Truan, and A. J. Engilis. 2015. Summer vs. winter: Examining the temporal distribution of avian biodiversity to inform conservation. *The Condor* **117**:560-576.

(Abstract)

Winter habitat quality plays a key role in avian population regulation, and conservation of winter habitat is a priority for waterfowl, shorebirds, and Neotropical migrant landbirds. Yet, there has been little discussion of the importance of conserving temperate wintering habitat for landbirds, including the billions of Neotemperate migratory landbirds that winter in the United States. The value and impact of conservation initiatives in the U.S. could be maximized by accommodating the habitat requirements of bird communities throughout the full annual cycle, particularly in the southern and western U.S. where winter species richness is concentrated. To estimate the degree to which winter bird communities should be a conservation priority, we examined the temporal distribution of avian diversity using riparian habitat in the lower Cosumnes River and lower Putah Creek watersheds in California's Central Valley. We used hierarchical multispecies occupancy models to estimate seasonal species richness and phylogenetic diversity in each watershed. We found that total species richness was equally as high in winter as in summer, and that phylogenetic diversity was higher in winter, with a considerable proportion of the winter avian diversity attributable to boreal-breeding Neotemperate migrants. Our results provide evidence that maintaining and restoring high-quality riparian habitat for winter bird communities in California is an important conservation opportunity. Broader recognition of the diversity of temperate winter bird communities and additional research into the factors affecting body condition and survival would facilitate effective conservation of high-quality winter habitat, benefiting Neotemperate migrants and year-round residents during a season that can have important impacts on their population dynamics.

Musilová, Z., P. Musil, J. Zouhar, and D. Romportl. 2015. Long-term trends, total numbers and species richness of increasing waterbird populations at sites on the edge of their winter range: cold-weather refuge sites are more important than protected sites. *Journal of Ornithology*

(Abstract)

Recent climate changes are most likely the major determining factor for the increasing importance of Central Europe for wintering waterbirds, given that most of the region is located on the edge of these species' wintering ranges. A few recent large-scale studies have

demonstrated changes in species distribution at the flyway level, but detailed studies at the site level are still scarce. Using mid-January wintering waterbird counts from 532 sites taken over a 48-year period (1966–2013), we have assessed the role of 'cold-weather refuges', i.e. sites where the selective pressures of winter harshness are reduced (e.g. sites with ample sources of running water, urban areas, warmer sites, sites with a relatively higher proportion of wetlands), and a site's protection status on species richness, total numbers and trends at the site level. We found prevailing increasing trends in total numbers and species richness at the site level, which are in line with the area's increasing importance as wintering grounds. However, some sites have likely been affected by density-dependent regulation as mean total numbers per site have not increased since the 1990s. Density dependence may also be a reflection of an increasing number of sites with running water in traditionally cold areas. Factors affecting trends in species richness at the site level are however less predictable. We demonstrate the great importance of cold-weather refuges, where running water has an effect on total numbers, species richness and trend affect total numbers, warmer areas and higher proportions of wetlands in the surroundings affect total numbers and species richness and urban areas affect total numbers. However, we found that legislative safeguards for sites, such as the establishment of Nature Reserves and Special Protection Areas, have no significant effects. Our findings therefore suggest that the effect of temperature and presence of cold-weather refuges (as defined here) are more relevant to this observed increasing trend of wintering waterbirds on the edge of wintering ranges than a reduction in human developmental pressures.

Hansen, B. D., P. Menkhorst, P. Moloney, and R. H. Loyn. 2015. Long-term declines in multiple waterbird species in a tidal embayment, south-east Australia. *Austral Ecology* **40**:515–527.

(Abstract)

Worldwide, local extinctions and severe declines in waterbird densities are being reported from many important waterbird sites. Waterbird sites often exist as a network, collectively providing crucial habitat for different life history stages of different species. Therefore, population changes at one site may strongly influence others. In Australia, many waterbird species are highly mobile, and move rapidly over long distances in response to rainfall. Large tidal wetlands often serve as drought refugia or alternative breeding habitat for these species. These sites are also the migration terminus of many species of shorebirds that spend their non-breeding season in Australia. One such site in south-eastern Australia is Western Port, a Ramsar-listed tidal embayment forming part of the East Asian–Australasian Shorebird Site Network. We measured waterbird population trends over nearly 40 years in Western Port to see whether changes showed consistent trends over time across multiple species. Thirty-nine species were recorded often enough to allow an analysis of trends over time using dynamic linear models and, where appropriate, piecewise linear regression. Twenty-two species had declined, including four species of duck, five species of fish-eating bird (cormorants, terns and pelicans), one species each of grebe, gull and heron, and 10 species of shorebird. Only two

species (Australian pied oystercatcher *Haematopus longirostris* and straw-necked ibis *Threskiornis spinicollis*) increased significantly over the same time period. Patterns of decline in non-migratory waterbirds may reflect diminishing wetland availability, local reductions in fish prey, increased predation pressure and changes in inland wetland resources. Declines in migratory shorebirds are most likely related to loss of habitat elsewhere in their trans-equatorial migration routes. These trends in waterbirds that use Western Port reflect widespread impacts on populations elsewhere in Australia and overseas, necessitating more than simply local management of this tidal embayment.

Bai, Q., J. Chen, Z. Chen, G. Dong, J. Dong, W. Dong, V. W. K. Fu, Y. Han, G. Lu, J. Li, Y. Liu, Z. Lin, D. Meng, J. Martinez, G. Ni, K. Shan, R. Sun, S. Tian, F. Wang, Z. Xu, Y.-t. Yu, J. Yang, Z. Yang, L. Zhang, M. Zhang, and X. Zeng. 2015. Identification of coastal wetlands of international importance for waterbirds: a review of China Coastal Waterbird Surveys 2005–2013. *Avian Research* **6**:12.

(Abstract)

Background: China's coastal wetlands belong to some of the most threatened ecosystems worldwide. The loss and degradation of these wetlands seriously threaten waterbirds that depend on wetlands.

Methods: The China Coastal Waterbird Census was organized by volunteer birdwatchers in China's coastal region. Waterbirds were surveyed synchronously once every month at 14 sites, as well as irregularly at a further 18 sites, between September 2005 and December 2013.

Results: A total of 75 species of waterbirds met the 1% population level Ramsar listing criterion at least once at one site. The number of birds of the following species accounted for over 20% of the total flyway populations at a single site: Mute Swan (*Cygnus olor*), Siberian Crane (*Grus leucogeranus*), Far Eastern Oystercatcher (*Haematopus osculans*), Bar-tailed Godwit *(Limosa lapponica*), Spotted Greenshank (*Tringa guttifer*), Great Knot (*Calidris tenuirostris*), Spoon-billed Sandpiper (*Calidris pygmeus*), Saunders's Gull (*Larus saundersi*), Relict Gull (*Larus relictus*), Great Cormorant (*Phalacrocorax carbo*), Eurasian Spoonbill (*Platalea leucorodia*), Black-faced Spoonbill (*Platalea minor*) and Dalmatian Pelican (*Pelecanus crispus*). A total of 26 sites supported at least one species of which their number met the 1% criterion. Forty-two species met the 1% criterion in the Yellow River Delta, Shandong; 29 at the Cangzhou coast, Hebei and 26 species at the Lianyungang coast, Jiangsu.

Conclusions: The results highlight the international importance of China's coastal wetlands for waterbirds. This study also demonstrates that participation of local birdwatchers in waterbird surveys results in data that are invaluable not only for understanding the current status of waterbirds in China's coastal regions but also for waterbird conservation and management.

Bino, G., R. T. Kingsford, and J. Porter. 2015. Prioritizing Wetlands for Waterbirds in a Boom and Bust System: Waterbird Refugia and Breeding in the Murray-Darling Basin. *PLoS ONE* **10**:e0132682.

(Abstract)

Dryland rivers have considerable flow variability, producing complex ecosystems, processes, and communities of organisms that vary over space and time. They are also among the more vulnerable of the world's ecosystems. A key strategy for conservation of dryland rivers is identifying and maintaining key sites for biodiversity conservation, particularly protecting the quantity and quality of flow and flooding regimes. Extreme variability considerably challenges freshwater conservation planning. We systematically prioritised wetlands for waterbirds (simultaneously for 52 species), across about 13.5% of the Murray-Darling Basin (1,061,469 km2), using a 30-year record of systematic aerial surveys of waterbird populations. Nine key wetlands in this area, primarily lakes, floodplains, and swamps, consistently contributed to a representation target (80%) of total abundances of all 52 waterbird species. The long temporal span of our data included dramatic availability (i.e., booms) and scarcity (i.e., busts) of water, providing a unique opportunity to test prioritisation at extremes of variation. These extremes represented periods when waterbirds were breeding or concentrating on refugia, varying wetland prioritisation. In dry years, important wetlands for waterbirds were riverine and lacustrine (12 wetlands) but this changed in wet years to lacustrine and palustrine (8 wetlands). Such variation in ecosystem condition substantially changes the relative importance of individual wetlands for waterbirds during boom and bust phases. Incorporating this variability is necessary for effective conservation of Murray-Darling Basin waterbirds, with considerable generality for other similarly variable systems around the world.

Arzel, C., M. Rönkä, H. Tolvanen, N. Aarras, M. Kamppinen, and P. Vihervaara. 2015. Species Diversity, Abundance and Brood Numbers of Breeding Waterbirds in Relation to Habitat Properties in an Agricultural Watershed. *Annales Zoologici Fennici* **52**:17-32.

(Abstract)

Land-use changes and the resulting habitat degradation have been regarded as the most important known causes of waterfowl population declines. We assessed the habitat requirements of waterbirds, including waterfowl, in a hemiboreal, agricultural watershed in southern Finland. We related the birds' species diversity, abundance and brood numbers on ten lakes to environmental variables, including land use characteristics as well as topographic and local biotic features. Both species diversity and pair numbers responded to land use characteristics, such as the area of agricultural land surrounding the lakes. Our results suggest that land use may reflect habitat quality, possibly in terms of resource availability and predation risk. The pair numbers of waterbirds grew along with the availability of invertebrates, an

important food resource. The abundance of gulls affected the diversity, abundance and reproductive success of waterfowl positively in our study area, probably because they provided shelter from predators.

Di Santo, M. P., G. M. Carpaneto, and C. Battisti. 2015. Water-related bird assemblages in an urban pond 'archipelago': Winter patterns of bird species occurrence, abundance and richness. *Lakes and Reservoirs: Research and Management* **20**:33–41.

(Abstract)

This study reports on the patterns of species occurrence, abundance and richness of a wintering water-related bird assemblage in an 'archipelago' of 70 small artificial urban ponds (AUPs) embedded in a metropolitan landscape (Rome, central Italy). A total of 20 species in 26 AUPs were sampled. Only the largest AUPs (>0.1 ha) contained all these species, except for *Gallinula chloropus*. The highest total mean species abundance was observed in the largest ponds, with statistically significant differences evident among size classes. Two significant spatial thresholds in species abundance and richness were observed (between 0.01 and 0.1 ha; between 0.1 and 1 ha in size). The abundance of single species was correlated with their frequency of occurrence. Ponds in urban areas must be larger than 0.1 ha to host a rich winter assemblage of birds, with a further increase in richness noted with a surface area larger than 1 ha. The highest number of species was observed in the larger ponds (>1 ha). The species richness of each AUP is directly correlated to their size (log-transformed species–area relationship: log S = 3.515 + 0.497 log A; R2 = 0.76). Further research should be conducted to confirm these patterns and to implement information useful for planning and management of artificial ponds in urban areas for this purpose.

Zhang, G.-G., D.-P. Liu, H.-X. Jiang, K.-J. Zhang, H.-D. Zhao, A.-L. Kang, H.-T. Liang, and F.-W. Qian. 2015. Abundance and Conservation of Waterbirds Breeding on the Changtang Plateau, Tibet Autonomous Region, China. *Waterbirds* **38**:19-29.

(Abstract)

The Changtang Plateau is located in the northern part of Tibet in western China, with the most numerous, high altitude lake complexes in the world. High altitude lakes (n = 48) were visited from July to August 2008, to investigate the summer abundance and distribution of waterbirds. A total of 43,143 individuals of 49 waterbird species were recorded during our survey. Among them, the most abundant were Bar-headed Goose (*Anser indicus*), followed by Brown-headed Gull (*Larus brunnicephalus*), Ruddy Shelduck (*Tadorna ferruginea*) and Great Black-headed Gull (*L. ichthyaetus*). These four species comprised 81.2% of all the waterbirds counted. A total of 12,796 Bar-headed Geese were counted at 39 lakes and comprised 29.6% of total

birds counted. The lakes with greatest number of individuals were Dong, Rebang, Kunzhong, Yaduo, and Yueqia; the lakes with greatest species richness were Bangong, Dangreyong, Aiyong, Yaduo, and Zharinanmu, while the lakes with greatest bird species diversity were Dangreyong, Bangong, Kunzhong, and Aiyong. In addition, a total of 514 Black-necked Cranes (*Grus nigricollis*) were counted at 39 lakes, including 326 individuals in Nagqu Prefecture and 188 in Aili Prefecture. There were significant differences between the waterbird species, among the different salinities of the lakes and with the area of the lakes. The principal long-term threat to lakes in the Changtang region is wetland degradation, primarily from mineral exploitation.

Figarski, T., and Ł. Kajtoch. 2015. Alterations of riverine ecosystems adversely affect bird assemblages. *Hydrobiologia* **744**:287–296.

(Abstract)

The alteration of flow regimes is the most serious threat to the environment and populations of riverine ecosystems. The aim of this study was to verify how newly recovered assemblages of riverine birds react to recent and intensive water control transformations. Data on habitat transformations, breeding bird species and population abundance within submontane river channels in southern Poland were compared before and after river regulation. Regulation works affected approximately one-third of river sections in the drainages studied. Simultaneously, large amounts of gravel, clay and woody debris were removed from river channels, and river channels became overgrown by dense vegetation. Regulation works carried out in river channels, previously restored by severe flood, led to a strong decline in breeding bird assemblages (23% decrease of species richness and 33% decrease of population abundance). These results show that river regulation can significantly alter the structure of breeding bird assemblages, and such change is generally negative for bird diversity (especially for rare and vulnerable species). Riverine habitats are some of the most important biodiversity hotspots and major routes of migration for organisms in Europe, so the degradation of riverine ecosystems can have a catastrophic impact on nature in the entire European Union.

Katayama, N., Y. G. Baba, Y. Kusumoto, and K. Tanaka. 2015. A review of post-war changes in rice farming and biodiversity in Japan. *Agricultural Systems* **132**:73–84.

(Abstract)

Flooded rice fields can provide habitats for wetland species and ecosystem services similar to those of natural wetlands. During the last three decades, however, farming practices and management systems have been intensified in many rice-producing countries. In addition,

more recent socioeconomic changes have caused agricultural abandonment in some parts of East and Southeast Asian countries such as Japan. This study reviewed long-term statistics on rice farming, as well as the impact of agricultural intensification and abandonment on farmland biodiversity at multiple spatial scales in Japan. The impact of pesticide use was greatest in the 1950s–1970s, when the use of highly toxic agents had not yet been prohibited. More recently, different components of agricultural intensification have been the largest threat for various taxa, for example, chemical pesticides for aquatic plants and invertebrates and modern efficient irrigation/drainage systems for amphibians, fishes, and waterbirds. The negative impacts of agricultural abandonment on farmland species have been rapidly increasing with the expansion of abandoned fields and the subsequent vegetation succession and loss of habitat heterogeneity. We also discuss the effectiveness of environmentally friendly farming practices, including the reduced use of pesticides, winter paddy flooding, and installation of fishways, to reduce the negative impacts of agricultural intensification on farmland species in rice-paddy landscapes.

## Waterbirds general 2014

Li, F.-S., W. Liu, Z.-J. Li, Q. Liu, J.-D. Wu, S. Hong, R.-B. Wang, and Y.-X. Shi. 2014. Numbers of wintering waterbirds and their changes over the past 20 years at Caohai, Guizhou Province. *Zoological Research* **35**:85−91.

(Abstract)

Caohai, lying on the eastern Yunnan and Guizhou Plateau, is the most important wintering and stopover area for waterbirds in the southwestern China. To document species, their populations, and changes of waterbirds wintering at Caohai, a survey was conducted on 11-12 January 2012. Twenty-six species of waterbirds, with a total of 76,872 individuals were recorded. Of the 26 species of waterbirds, 8 species had a population of more than 1,000, including Common Teal (*Anas crecca*), Black-necked Crane (*Grus nigricollis*), Spot-billed Duck (*Anas poecilorhyncha*), Bar-headed Goose (*Anser indicus*), Tufted Duck (*Aythya fuligula*), Ruddy Shelduck (*Tadorna ferruginea*), Eurasian Wigeon (*Anas penelope*), and Coot (*Fulica atra*). Coot, Eurasian Wigeon, and Ruddy Shelducks each had population of near 10,000 or more. Over the past 20 years, the total counts of waterbirds have been between 50,000-80,000. Numbers of Black-necked Cranes have been increasing steadily, while Eurasian Cranes (*Grus grus*) have been declining. The number of diving ducks is far less than the number of 10,000 diving ducks in 1996, likely due to the decline in water quality at Caohai over the past decades. We recommended the following measures be taken into account in waterbird monitoring and protection: more systematic waterbird count; special attention paid to species or groups with dramatic increase or decrease; land use and change to be monitored; and urgent measures to be taken on pollution, invasive species, urban expansion, and tourists.

Golubev, S. V., and M. V. Suin. 2014. Data on the summer avifauna of the northern coast of Chukotka. *Far Eastern Journal of Ornithology* **4**:20-41.

(Abstract)

From May-July 2011, the avifauna of the Chukchi Sea coast between the villages of Nutepelmen and Vankarem (a distance of 70 km) were investigated. This is the first study to examine the summer avifauna of this section of northern Chukotka. Eighty-two bird species were identified during the expedition, 25 of which were confirmed breeders, 19 species were suspected of breeding, 32 species were either migratory or summered in the area, and 6 species were vagrants.

Golawski, A., Z. Kasprzykowski, C. Mitrus, and T. Stanski. 2014. Observations of waterbirds on migration along two rivers in northern China during August 2010. *Forktail* **30**:138-141.

(No abstract available)

Lok, T., O. Overdijk, and T. Piersma. 2014. Interpreting variation in growth of Eurasian Spoonbill chicks: disentangling the effects of age, sex and environment. *Ardea***102**:181–194

(Abstract)

Chick body condition can be a sensitive indicator of local environmental conditions and has been shown to be correlated with chick survival. Designing a reliable index of chick body condition for a given species from a single measurement point requires knowledge about the extent of variation in body size, about chick age and about the relative sensitivity of the growth of different biometric measures to variation in environmental conditions. To gain this knowledge, we describe sex-specific variation in growth of several morphometric measures and body mass of Eurasian Spoonbills *Platalea leucorodia*. We repeatedly measured 35 chicks that grew up in small colonies on the island of Schiermonnikoog to derive detailed growth curves until fledging (based on the 12 surviving chicks) and to assess the extent of reduction in growth of starved chicks measured at least twice (n = 11) compared to those that survived. Growth curves until fledging were compared with biometric measurements of two to five-week-old chicks from (mostly) larger colonies of which hatching date was accurately estimated (n = 631). Growth of all measures, except the eighth primary, was sex-specific, with the most pronounced sex effect on the asymptotic values of tarsus length and body mass: adult males were predicted to become 17% heavier than females and to have 22% longer tarsi

than females. Body mass and tarsus growth tended to be more reduced under food deprivation than (head-)bill and eighth primary growth. As an index of chick body condition, we propose to use the proportional deviation in body mass from the predicted body mass for a given age and sex. To do so, measurements of nearly fledged Spoonbill chicks should include at least eighth primary length to estimate age, tarsus length to estimate sex, and body mass as a measure that integrates age, sex and environmental effects.

Gutiérrez, J. S. 2014. Living in Environments with Contrasting Salinities: A Review of Physiological and Behavioural Responses in Waterbirds. *Ardeola* **61**:233-256.

(Abstract)

During the course of their lives many vertebrates live and forage in environments characterized by different salinities and must therefore respond to changes in salt intake. This is particularly true for numerous species of migratory waterbirds, especially those that routinely commute between saltwater and freshwater wetlands throughout their annual cycle and/or within a season. These birds have evolved a suite of morphological, physiological and behavioural mechanisms to successfully maintain osmoregulatory balance. However, relatively little is known about the impacts of salinity on the distribution, physiological performance and reproductive success of waterbirds. Here I review the current knowledge of the physiological and behavioural mechanisms through which waterbirds cope with contrasting salinities and how some of the adjustments undertaken might interfere with relevant aspects of their performance. I argue that, because of their strong reliance on wetland ecosystems for foraging and breeding, waterbirds may be particularly vulnerable to climate-induced changes in salinity, especially in arid or semiarid tropical areas where increases in both temperature and salinity may affect their body condition and, ultimately, survival prospects. I conclude by offering some suggestions for future research that could take us beyond our current level of understanding of avian osmoregulation.

Cui, P., Y. Wu, H. Ding, J. Wu, M. Cao, L. Chen, B. Chen, X. Lu, and H. Xu. 2014. Status of Wintering Waterbirds at Selected Locations in China. *Waterbirds* **37**:402-409.

(Abstract)

Wetlands are under enormous pressure due to rapid economic development in China. Waterbirds, which depend on wetlands, are therefore facing a dramatic threat. Surveys were conducted in 19 Provinces in the winters of 2011/2012 and 2012/2013. Sites that support internationally important numbers of waterbirds were selected. Seven sites that support 20,000 or more waterbirds and 48 sites that support more than 1% of the global or flyway population of at least one species were found in our survey. Ten (20.8%) of these sites were

protected and 10 (20.8%) had no protection. Eight of the 10 unprotected sites were located along coastlines. Of 16 coastal wetland sites, 43.8% were unprotected. The protection of wintering sites of waterbirds should be made a priority and more wetland sites, especially coastal wetland sites, should be protected. Additionally, an intensive site survey should be conducted to gain comprehensive knowledge of the distribution of wintering waterbirds in China to better protect waterbirds and their habitats.

Guareschi, S., P. Abellán, A. Laini, A. J. Green, J. A. Sánchez-Zapata, J. Velasco, and A. Millán. 2014. Cross-taxon congruence in wetlands: Assessing the value of waterbirds as surrogates of macroinvertebrate biodiversity in Mediterranean Ramsar sites. *Ecological Indicators* **49**:204–215.

(Abstract)

Wetlands are among the most threatened habitats and the species they support among the most endangered taxa. Measuring and monitoring wetland biodiversity is vital for conservation, restoration and management, and often relies on the use of surrogate taxa. Waterbirds are commonly used as flagships of biodiversity and are the subject of major conservation initiatives. Therefore, it is important to assess the extent to which waterbirds indicate the general biodiversity of wetlands and serve as surrogates. We explore the relationships between community composition and species richness of waterbirds and aquatic macroinvertebrates in 36 Ramsar wetlands in southern Spain to assess if waterbirds are good surrogates for other taxonomic groups. Specifically, we aimed to (i) test the congruence of patterns of species composition and richness among waterbirds and aquatic macroinvertebrates; and (ii) investigate which environmental variables are associated with the biodiversity patterns of waterbirds and macroinvertebrates, with the purpose of identifying key factors explaining potential discordance in these patterns. We found a limited concordance between assemblage patterns of both taxonomic groups that may be related to their contrasting responses to environmental gradients. Assemblages of waterbirds appear to be more affected by climate variables and water surface area, whereas conductivity was the most important factor influencing macroinvertebrate communities. Furthermore, we found a negligible or inverse relationship in their patterns of richness, with wetlands with higher waterbird species richness showing significantly lower richness of Hemiptera and macroinvertebrate families, and no significant relationship with Coleoptera. In addition, GLM models showed that, in general, different environmental variables are related with the richness patterns of the different taxonomic groups. Given the importance of the Ramsar convention for the conservation of an international network of wetlands, our findings underline the limited potential of waterbirds as aquatic biodiversity indicators in Mediterranean wetlands, and the need for caution when using waterbirds as flagships. An integrative analysis of different biological communities, using datasets from different taxonomic groups, is a necessary precursor for successful conservation policies and monitoring. Our results illustrate the need to create a diversified and complete network of protected sites able to conserve multiple components of wetland biodiversity.

Trainor CR, Hidayat O. 2014. Kupang Bay: an internationally significant wetland in West Timor, Indonesia. *Birding ASIA* **21**, 45–50.

(No abstract available)

Munira AN, Salmi ALN, Anuar MSS, Muin MAMA, Amirrudin A, Juliani SN. 2014. Diversity and Temporal Distribution of Birds in Rice-Growing Landscape, Northern Peninsular Malaysia. *Sains Malaysiana* **43**, 513-520.

(Abstract)

Rice fields are traditional landscape in Malaysia that sustains various species of birds. Waterbirds, raptors, Passeriformes and Columbiformes were observed and counted using point count method at rice fields in Bandar Baharu, Kedah from March 2009 to February 2010. The current status of birds in the rice fields of Malaysia has not been widely researched. The objective of this study was to document the bird species richness and diversity and temporal bird distribution during the annual rice growing cycle. There were 5120 birds representing 67 species belonging to 29 families being recorded. The diversity index (Shannon-Wiener) varied monthly between 2.154 and 3.321. The most abundant bird family observed was Ardeidae (29.09%), followed by Sturnidae (10.15%) and Hirundinidae (7.86%). Rice growing seasons involve three main stages; direct seedling/transplanting, growing and harvesting. Each stage attracts different bird species to exist in the rice field and surrounding areas. Statistical analysis showed the alternative hypothesis that states abundance of bird species is different monthly was accepted ($F_{11, 24} = 3.033$, $p < 0.05$). Farming activities and rice growing seasons regularly influenced birds' presence in the rice fields and attracted different bird species. Reclamation and urban development on the rice fields is a major concern. Conservation efforts and strict regulation of pesticide use should be implemented to develop sustainable agriculture practices that are beneficial to human and wildlife communities.

Shao M, Jiang J, Guo H, Zeng B. 2014. Abundance, Distribution and Diversity Variations of Wintering Water Birds in Poyang Lake, Jiangxi Province, China. *Pakistan Journal of Zoology* **46**, 451-462.

(Abstract)

Bird abundance, distribution, and diversity in five regions of Poyang Lake, Jiangxi Province were investigated from October 2012 to April 2013. A total of 68 species were recorded. Bean goose (*Anser fabalis*), Tundra swan (*Cygnus columbianus*), and swan goose (*Anser cygnoides*) were dominant in Poyang Lake during this study. Dominant species differed in the five regions, although bean goose was the common dominant species in four regions. Most dominant or common species had no significant differences among the five regions. Bird composition was similar among Poyang Baishazhou Natural Reserve (BSZ), Nanjishan Wetland Nature Reserve (NJS) and Duchang Migratory Bird Reserve (DC), and many species had similar preferences for these three regions. The number of species in DC was high for most times. Bird diversity was higher in mid-winter than in early or late winter with the exception of NJS. PWC and PHF had steady and high evenness index. Podicipediformes was very common in early or late winter in all study regions because shallow areas dominated in our study area during midwinter. The proportion of Gruiformes increased gradually in PWC, PHF, and BSZ from November. Charadriiformes had lower proportions in NJS and BSZ. The Anseriformes proportion rapidly increased in most regions in November and stayed high until March, then decreased gradually. Ciconiiformes had high proportion in PWC and PHF in October and January, indicating that this species migrated to breeding sites earlier; this may be related to its long hatching and incubation period. A repeatable and robust sampling protocol should be developed to monitor the birds studied here, and to report annually.

Gönner C, Schwarz S, Budiono, Kreb D, Soeyitno A. 2014. Waterbird Population Dynamics in the Middle Mahakam Wetlands of East Kalimantan over 23 years. *Kukila***17**, 20-41.

(Abstract)

Between 1988 and 2011, a total of 57 species of waterbirds, as well as twelve raptor and six kingfisher species regularly utilizing wetlands, were recorded in the Middle Mahakam Wetlands of East Kalimantan, Indonesia. Waterbirds included 27 shorebird species from five families, twelve herons (Ardeidae), six rails and crakes (Rallidae), four terns (Sternidae), three ducks (Anatidae) and two storks (Ciconiidae). Based on IUCN (2013) criteria, six listed species are threatened: one (White-shouldered Ibis) is Critically Endangered, another (Storm's Stork) is Endangered and four (Chinese Egret, Lesser Adjutant, Wallace's Hawk-Eagle, Blue-banded Kingfisher) are Vulnerable. The Middle Mahakam Wetlands are one of Borneo's most important wetland areas. They are part of a highly dynamic landscape that has historically changed its appearance many times. Today, the birds of these unique wetlands are endangered by a plethora of threats comprising large scale land conversion, fire, hunting and live capture of waterbirds, illegal logging and pollution. Despite the considerable efforts of local NGOs to address some of these issues, conservation measures are still limited and insufficient to protect this natural asset.

Jiang, K., M. Wu, X. Shao, and Y. Lü. 2013. Diversity of bird communities in southern Hangzhou Bay and the Qiantang River estuary and their responses to reclamation of intertidal mudflats. *Biodiversity Science* **21**:214-223. (in Chinese with English abstract)

(Abstract)

Bird communities were surveyed in southern Hangzhou Bay and the Qiantang River estuary from November 2008 to September 2011. A total of 220 bird species belonging to 16 orders and 52 families were recorded, of which, 173 (78.6%) were migrants and 24 were listed as state key protected wildlife grade I or II. The composition and diversity of bird communities in eight habitat types were compared using the G-F index and the Jaccard index. Ninety-five species (43.2%) were observed in the ponds located in Cixi Wetland Centre with common reed (*Phragmites australis*) marshes, 93 species (42.3%) in the coastal woodland, and 78 species (35.5%) in intertidal mudflats and coastal reservoirs. About 82.5% of the *Charadriiformes* species were recorded in intertidal mudflats; 69.2% of the *Anatidae* species in coastal reservoirs, and 73.4% of the Passeriformes species in the coastal woodland which provides the breeding habitat for the *Ardeidae* birds. Compared with intertidal mudflats, the highest value of the Jaccard index was obtained for bird communities in the newly reclaimed but undeveloped areas (0.56), followed by coastal reservoirs (0.34) and ponds located in Cixi Wetland Centre with common reed marshes (0.30). For the whole bird community, the highest value of G-F index was obtained in coastal reservoirs and coastal woodland, whereas the lowest value was recorded in the intertidal mudflats. However, newly reclaimed but undeveloped sites had the highest value of G-F index for the waterbird community, followed by coastal reservoirs and intertidal mudflats. Our results indicate that suitable habitat availability and human disturbance are the main factors influencing the spatial distribution of bird communities in the Hangzhou Bay and the Qiantang River estuary. The most serious human disturbance in this region was found to be coastal reclamation. Thus, diversity of local avian communities in the Hangzhou Bay and the Qiantang River estuary could increase if moderate-intensity reclamation and reasonable land use patterns were practiced. Moderate-intensity reclamation is the mode that maintains an intertidal wetland containing a sufficient width of mudflat and upper intertidal zone as well as other important habitat variables for shorebirds and other birds. Local governments should take action to protect the natural wetlands while using them reasonably and efficiently. It is necessary to maintain several main high-tide roosting sites with sufficient areas for shorebirds and other waterbirds. Some appropriate management measures such as controlling water level in newly reclaimed but undeveloped areas should be carried out to increase the availability of suitable habitat for waterbirds. A variety of artificial wetlands should also be constructed to provide potential habitats for waterbirds and other birds after large scale coastal reclamation.

Hashimoto H, Sugawa H. 2013. Population trends of wintering Eurasian Coot *Fulica atra* in East Asia. *Ornithological Science* **12**, 91-105.

(Abstract)

The range of Eurasian Coot *Fulica atra* in Japan has expanded gradually since the 1980s, and the numbers of coot wintering at several sites in Japan have increased. In this paper, we summarize the trends in coot numbers wintering in Japan and mainland East Asia. In Japan, wintering numbers of coot have increased in most regions, except in northern Chiba Prefecture. The increase began in the late 1990s or around 2000 at several water bodies in the Kanto, Chubu, Kinki and Chugoku regions of Honshu. It also increased in the mid-2000s at several water bodies in the Tohoku, Kanto, Chubu, and Kinki regions of Honshu, and perhaps also on the island of Kyushu. In China, huge numbers of coot overwintered at several sites in the lower Yangtze floodplain (e.g., Poyang Lake, Dongting Lake) and along the Jiangsu Coast near the Yangtze River mouth (e.g., Yancheng Nature Reserve, Hongze Hu Lake) during the 1990s. However, during the 2000s, no sites in China held more than 10,000 wintering coot. The number of coot wintering in coastal south China has also decreased. In South Korea, the number of wintering coot has increased especially since the mid-2000s. The increases in the populations of wintering coot in central and western Japan and in South Korea seem to be mainly as a result of changes in coot populations and/or habitats outside Japan. We suggest two possible causes: the breeding population of coot on the East Asian mainland may have increased, or some coot that used to overwinter in China may have begun wintering in Japan and South Korea.

Ronchi-Virgolini AL, Lorenzón RE, Blake JG, Beltzer AH. 2013. Temporal variation of bird assemblages in a wetland: influence of spatial heterogeneity. *Avian Biology Research* **6**, 198–206.

(Abstract)

The temporal variation of bird assemblages at three sites within a wetland of the Parana River was examined. The aim was to obtain an overview of the influence of spatial heterogeneity on communities in such a variable environment as the wetlands. We recorded 1,662 individuals belonging to 139 species from 40 families. There were no significant differences between sites in richness, abundance nor diversity. Species richness in the first year was greater than during the second year. Number of resident and migrant species decreased in the second year. Community composition differed between the two years of study and was significantly different among seasons. Species were grouped into 19 trophic guilds. In this study, number of species and their abundances were not significantly different among sites; there were differences in the composition of birds among sites. Thus, the structure of the environments influenced the composition of assemblages in different areas. Guild composition remained fairly constant between years and among seasons. Geomorphological and hydrological dynamics of the river produce a heterogeneous availability of habitats and resources that affect the composition of

bird assemblages. Annual and seasonal changes in meteorological variables can lead to changes in the structure and/or composition of those assemblages.

Ramo C, Aguilera E, Figuerola J, Máñez M, Green AJ. 2013. Colonial wading birds breeding in Doñana (SW Spain) in relation to environmental and anthropogenic factors. *Ardeola* **60**, 305-326.

(Abstract)

Breeding season counts of nine species of colonial wading birds (*Nycticorax nycticorax*, *Ardeola ralloides*, *Bubulcus ibis*, *Egretta garzetta*, *Ardea cinerea*, *Ardea purpurea*, *Ciconia ciconia*, *Plegadis falcinellus* and *Platalea leucorodia*) nesting at Doñana during 1984-2010 were analysed. The aim of the study was to assess the size and trends of populations and to analyse their environmental and anthropogenic determinants. We used the TRIM programme to test for long-term trends, and Generalised Additive Models to assess the effect of local rainfall, the surface area of ricefields surrounding Doñana and rainfall in the Sahel on breeding population size. All species showed positive population trends, mainly from 1996 onwards. The number of active colonies increased over time, and up to 17,297 nests from the nine studied species were recorded in one year (2010). Low precipitation (< 500 mm) in the previous autumn and winter was associated with reductions in the numbers of breeders, since rainfall determines the flooding extent in the natural marshes of Doñana. The area of ricefields positively influenced the breeding numbers of five species. Only four of these species are considered to be increasing in Europe and increases in Doñana coincide with management changes that have improved nesting and feeding habitat and reduced human disturbance. In addition to large-scale man-made habitat changes, breeding population sizes for the studied species were strongly influenced by high annual variation in rainfall, typical of Mediterranean habitats, therefore making them likely to be affected by climate change.

Malik DS, Nidhi J. 2013. Habitat selection pattern of migratory avifauna in relation to nutrients in Asan wetland at Doon valley (Garhwal Himalaya), India. *International Journal of Recent Scientific Research* **4**, 1470-1475.

(Abstract)

Asan wetland is a rich, diverse and a well notified conservation reserve for sustaining a large migratory avian diversity. Migratory birds are an important biotic component of the wetland ecosystem as they occupy several trophic levels in the food web of wetland. Habitat ecological study of migratory and local birds in Asan wetland has been done during the winter season. The Asan wetland provides an optimum suitability of natural habitats for breeding, roosting, feeding etc. to rich repository migratory avifaunal population and supports them for their

annual migratory behaviour. The 21 migratory species in different flocks from four zones of wetland were observed during the study period. The maximum number of flocks were recorded in morning in Zone I but the high abundance was observed in Zone IV. Mostly the birds are carnivorous and feed mainly on Insects, Zooplanktons, Crustaceans, Water bugs, flies etc. The wetland is quite rich in nutrients and contributed significantly to enhancement of ecosystem productivity as a distinct food web cycle provides a substantial food spectrum to the avian fauna. The ecological characteristics of wetland were studied as dissolved oxygen in the range of (5.6-7.2 mg/l), Sulphate (1.32-1.36 mg/l), Calcium (24.17-25.43mg/l), Magnesium (12.83-13.27mg/l). The nitrate (0.29 mg/l -0.33 mg/l) and the phosphate (0.659-0.76 mg/l ) were recorded in all zones. The nitrate and phosphate are the limiting factor to denote the present trophic status of wetland in relation to productivity and status of species richness of biotic communities. The present study revealed that the availability of nutrients in wetland play a significant role in the selection of particular ecological niche by the migratory avifauna.

Sharma KK, Singh P. 2013. Dynamics of migratory waterfowl abundance at Lake Mansar (Ramsar site): A transient and wintering site. *International Journal of Current Life Sciences* ***3,*** *9-13.*

(Abstract)

Lake Mansar is situated in lower Shiwalik hills of Jammu & Kashmir state in northern part of India. The lake lies in Central Asian Flyway of migratory waterfowl. Thirty species of waterfowl wer recorded during this study, most of which used the lake as stopover site en-route autumn and spring migration. Among migratory waterfowl Common Teal *Anas crecca*, Northern Pintail *Anas acuta*, Gadwal Anas strepera, Northern Shoveller *Anas clypeata* and Common Pochard *Aythya ferina* used this lake as stop-over site during both autumn and spring migration while Greylag Goose *Anser anser*, Eurasian Wigeon *Anas penelope*, Ferruginous Pochard*Aythya nyroca*, Garganey *Anas querquedula* and Red-crested Pochard *Netta rufina*transit only during spring (return) migration. Black-necked Grebe *Podiceps nigricollis*, Great Crested Grebe *Podiceps cristatus*, Mallard *Anas platyrhynchos*, Common Moorhen *Gallinula chloropus* and Common Coot *Fulica atra* used this lake as wintering site. Among migratory waterfowl first to arrive were Common Teal, Common Coot and Common Moorhen in October, followed by Northern Pintail, Gadwal, Northern Shoveller and Tufted Duck *Aythya fuligula* in November, whereas last to arrive were Mallard, Common Pochard, Great crested Grebe and Black-necked Grebe in December, while Greylag Goose, Eurasian Wigeon, Garganey, Red-crested Pochard recorded only during March-April. Little Cormorant *Phalacrocorax niger*, Great Cormorant *Phalacrocorax carbo*, Pheasant-tailed Jacana *Hydrophasianus chirurgus* were local vagrant. Little Grebe *Tachybaptus ruficollis* and White-breasted Waterhen *Amaurornis phoenicurus* are only resident species, while Little Egret *Egretta garzetta*, Cattle Egret *Bubulcus ibis* and Indian Pond Heron *Ardeola grayii*immigrated from local area for breeding. Common Coot and Common Moorhen were most dominant species among migrants. Fluctuations in abundance and community structure

of waterfowl at this lake during different months of two years of present study are discussed in this paper.

Williamson L, Hudson M, O'Connell M, Davidson NC, Young R, Amano T, Székely T. 2013. Areas of high diversity for the world's inland-breeding waterbirds. *Biodiversity and Conservation* **22**, 1501-1512.

(Abstract)

Waterbirds are a globally-distributed, species-rich group of birds that are critically dependent upon wetland habitats. They can be used as ecosystem sentinels for wetlands, which as well as providing ecosystem services and functions essential to humans, are important habitats for a wide range of plant and animal taxa. Here we carry out the first global analysis of inland-breeding waterbird distributions using data from 471 waterbird species in 28 families to identify global areas of high waterbird diversity. First, we identify the primary area of high diversity for all inland-breeding waterbird species to be in Eastern Africa. For globally threatened inland-breeding waterbirds, the area of highest diversity is in Eastern China. Second, we show that the current network of protected areas provides poor coverage for threatened waterbirds in Eastern and Central Asia, and Northern India. In contrast, there is a higher protected area coverage in most of Europe and Brazil. Targeting the specific areas that have the highest numbers of species and the poorest coverage of protected areas is vital for both waterbird and wetland conservation.

Ryan PG. 2013. Medium-term changes in coastal bird communities in the Western Cape, South Africa. *Austral Ecology* **38,** 251–259.

(Abstract)

There are few studies of medium-term, quantitative changes in faunal communities in the southern hemisphere. The linear nature of coastlines makes populations of coastal birds easy to count. Repeat surveys of 278 km of coastline in three regions of the Western Cape, South Africa show marked differences in coastal bird community structure over the last 30 years, despite limited human impacts on coastal habitats (mainly increased human disturbance). The total number of birds has not changed, but species richness increased following colonization of the coast by Egyptian geese (*Alopochen aegyptiaca*, Anatidae) and three species of ibises (*Threskiornithidae*). Biomass also increased due to greater numbers of large-bodied birds. Contrary to the prediction that large birds are more susceptible to human disturbance, most small birds decreased in abundance. Among waders that breed along the coastline, numbers of African oystercatchers (*Haematopus moquini*, Haematopodidae) doubled, linked to increased food availability following invasions by alien mussels (Mytilidae). By comparison,

numbers of white-fronted plovers (*Charadrius marginatus*, Charadriidae) decreased by 37% (59% close to Cape Town), at least in part as a result of increasing human disturbance. The greatest decreases occurred among migrant waders (Scolopacidae and Charadriidae), with numbers of the four most abundant species falling by >50%, and both common *Calidris* species by >90%. Migrant wader populations decreased in all three regions, irrespective of whether surveys were in protected areas or not, suggesting that factors outside the region are driving these trends. Some species may have decreased due to changes in their preferred wintering areas, but others probably reflect population decreases, confirming the generally poor conservation status of migrant waterbirds worldwide.

## Waterbirds general 2012 and earlier

**2012**

Solovyeva, D. V. 2012. Long-term population dynamics of the bird fauna in the Chaun and Pucheveyem delta, West Chukotka, Russia, and possible causes of changes in selected species numbers. *Вестник СВНЦ ДВО РАН* **4**:57–65.

(Abstract)

The paper presents the syntheses of the fauna composition and bird densities in the Chaun delta, West Chukotka, Russia, in the cold (1970–1989) and warm (2002–2011) phases of the climatic cycle. There is an attempt to generally analyze nesting population dynamics as related to climatic or anthropogenic factors. Of 55 bird species known to nest in Chaun delta in 1970–1980s, only 44 species were reported in 2000s. One new nesting species appeared. The paper suggests methods for bird community monitoring and it provides maps of study plots for current and future monitoring.

Gluschenko, Y. N., I. N. Kalnitskaya, I. O. Katin, D. V. Korobov, and H. Liu. 2012. Faunistic notes on the birds of Primorye and adjacent areas of Northeast China. *Far Eastern Journal of Ornithology* **3**:53-60.

(Abstract)

This article presents data of avifaunistic interest collected in 2004–2012 in different regions of Primorye (primarily on the Khankaisko-Razdol'nenskaya Plain) and some adjacent areas of the Northeast China (Heilongjiang Province). One species (red-billed starling) is introduced into the avifauna of the Russian Federation for the first time, three species (green-winged teal,

red-crested pochard, and blackbird) are added to the checklist of birds of Primorye, and the record of Baird's sandpiper here was first documented.

Zhang, Y., Y. Jia, S. Jiao, Q. Zeng, D. Feng, Y. Guo, and G. Lei. 2012. Wuliangsuhai Wetlands: A Critical Habitat for Migratory Water Birds. *Journal of Resources and Ecology* **3**:316-323.

(Abstract)

Wuliangsuhai wetland is one of the representative wetlands in arid-semiarid region. It is also a key breeding site as well as a stepping site for both East Asia-Australasia Flyway and Central Asia Flyway. From 2009 to 2012, surveys on migratory waterbirds and their habitat were carried out by using transects census and spot count methods. The surveys recorded more than 100,000 waterbirds, and 98 species were identified, which belong to 6 orders and 14 families. Among the 98 species, 55 are summer residents (breeding here) and 39 are travellers (only stay here shortly), which account for 56.12% and 39.80% of the total recorded bird species respectively. Further analysis on their migration pattern shows that spring migration is mainly from early March to mid May, which is shorter than autumn migration season (from early August to mid November). Most of the summer residents breed from early April to late May. High concentration of key protected species were observed from early April to early May and from early September to early November. The bird community structure is relatively stable in summer, but much more dynamic during the migration seasons (spring and autumn). Based on the study, recommendation to nominate Wuliangsuhai wetlands as Ramsar site, and flyway network site were put forward. Habitat management that address to the environmental determinants on bird distribution was also discussed.

Huang G, Isobe M. 2012. Carrying capacity of wetlands for massive migratory waterfowl. *Hydrobiologia* **697**, 5–14.

(Abstract)

Although it has been documented that waterfowl can cause water quality problems when their populations are large relative to the size or volume of the water body, the question as to how many waterbirds a wetland or a lake can support remains unanswered. A method to quantify the carrying capacity of a water body with regard to massive waterfowl was developed through the study of five wetlands that are used as the wintering ground by a large number of waterfowl in Japan. It takes into consideration water depth, retention time, and in-lake phosphorus concentration. For one of the sites, Sakata Lagoon, which is a registered Ramsar wetland in Japan, the assessment of its carrying capacity suggests that the number of waterfowl should be reduced by half to sustain the water quality of this wetland. Based on the comparison among the five wetlands, a simple indicator was proposed for quick diagnosis. Moreover, a

general plot of permissible loading of phosphorus (kg/ha/year) by waterfowl was presented. Besides, this study shed some new light on potential toxicity and accumulation of waterfowl feces at lakebed. Finally, a proposal to increase the carrying capacity of Sakata Lagoon is discussed.

**2011**

Glushchenko, Y. N., V. P. Glushchenko, and E. B. Lebedev. 2011. Results of 2006 Waterbird Surveys on Sakhalin Island's Northeastern Shelf. Far Eastern *Journal of Ornithology* **2**:56-78.

(Abstract)

Data on phenology and intra-seasonal population dynamics are described for 52 species of waterbirds resulting from ship-based visual surveys conducted from late June to October 2006 off the northeastern coast of Sakhalin Island, Russia. Estimates of population age structure and polymorphic manifestations are possible for species that are easily-distinguished by age and individual plumage variability.

Trainor CR. 2011. The waterbirds and coastal seabirds of Timor-Leste: new site records clarifying residence status, distribution and taxonomy. *Forktail* **27**, 63-72.

(Abstract)

The status of waterbirds and coastal seabirds in Timor-Leste is refined based on surveys during 2005–2010. A total of 2,036 records of 82 waterbird and coastal seabirds were collected during 272 visits to 57 Timor-Leste sites, and in addition a small number of significant records from Indonesian West Timor, many by colleagues, are included. More than 200 new species by Timor-Leste site records were collected. Key results were the addition of three waterbirds to the Timor Island list (Red-legged Crake *Rallina fasciata*, vagrant Masked Lapwing *Vanellus miles* and recent colonist and Near Threatened Javan Plover *Charadrius javanicus*) and the first records in Timor-Leste for three irregular visitors: Australian White Ibis *Threskiornis molucca*, Ruff *Philomachus pugnax* and Near Threatened Eurasian Curlew *Numenius arquata*. Records of two subspecies of Gull-billed Tern *Gelochelidon nilotica*, including the first confirmed records outside Australia of *G. n. macrotarsa*, were also of note.

Kingsford RT, Porter JL, Halse SA. 2011. 'National waterbird assessment.' National Water

Commission, Canberra.

(Abstract)

Waterbirds provide a useful indicator of river and wetland condition in Australia that can be monitored across large spatial scales. Given the long history of waterbird research in Australia, waterbirds also provide a rare opportunity to assess long-term temporal trends in the ecological status of water-dependent ecosystems as well as in this iconic group of species. Understanding spatial and temporal trends in waterbird numbers has considerable significance both in terms of informing conservation and sustainable natural resource management as well as in meeting national and jurisdictional obligations to a wide range of conservation agreements of relevance to waterbirds (e.g. migratory bird treaties) and the wetlands which support them (e.g. the Ramsar Convention). The National Water Resource Assessment Using Waterbirds: Ecosystem Health and Conservation Importance of Water-Dependent Ecosystems and Rivers project was funded by the National Water Commission and undertaken by the Australian Wetlands and Rivers Centre at the University of New South Wales, with the support and involvement of all state governments. The project addressed three major objectives:

– design and completion of a national survey of waterbirds in all major wetlands of Australia holding water in 2008
– assessment of long-term changes in waterbird numbers in relation to flow in key wetlands of eastern Australia, using data from the Eastern Australia Aerial Waterbird Survey
– design and establishment of a national waterbird database to store and access waterbird survey data.

**2007**

Cao L, Liu NF. 2007. Waterbirds of the Xisha Archipelago, South China Sea. *Waterbirds* **30**, 296-300.

(Abstract)

The Xisha Archipelago, South China Sea, was surveyed for waterbirds in March-April 2003 and April-August 2004. Forty-five waterbird species were recorded, making a grand total of 53 species for the Archipelago when earlier published records are included. The Archipelago is of great importance for the Red-footed Booby (*Sula sula*), with an estimated 10% of the world population breeding on Dong Island. Other breeding seabird species were Great Frigatebird (*Fregata minor*), Great Crested Tern (*Sterna bergii*) and Sooty Tern (*S. fuscata*), and it is believed that Black-naped Tern (*S. sumatrana*) and Roseate Tern (*S. dougallii*) also breed there. Compared to 1926, the number of seabirds, and the islands on which they breed, has declined greatly. The data for Ardeidae and shorebirds provide information on migration and, possibly, wintering strategies of these species. Despite habitat degradation and human disturbance, the Xisha Archipelago is still important for breeding seabirds and there is an urgent need to improve the conservation status of this bird group.

**2005**

Trainor CR. 2005. Waterbirds and coastal seabirds of Timor-Leste (East Timor): status and distribution from surveys in August 2002–December 2004. *Forktail* **21**, 61-78.

(Abstract)

Field surveys were carried out in 2002–2004 to assess the status, distribution and seasonality of waterbirds and coastal seabirds in Timor-Leste. A total of 3,653 records of 82 waterbird and coastal seabirds were collected during 446 visits to 74 wetland sites. Ten species new to Timor island were recorded: Green Pygmy-goose *Nettapus pulchellus*, Hardhead *Aythya australis*, Ruddy-breasted Crake *Porzana fusca*, Spotless Crake *Porzana tabuensis* (first Wallacean record since 1899), Common Coot *Fulica atra*, Greater Painted-snipe *Rostratula benghalensis*, Spotted Redshank *Tringa erythropus* (second record for Wallacea), Pectoral Sandpiper *Calidris melanotos* (first record for Wallacea), Common Tern*Sterna hirundo* and Black-crowned Night Heron *Nycticorax nycticorax*. Significant populations of three Near Threatened species were recorded: Beach Thick-knee *Esacus neglectus*, Malaysian Plover *Charadrius peronii* and Darter *Anhinga melanogaster*. Three wetlands are highlighted for their importance: (1) Lake Iralalara (c.1,500 ha) is the most significant freshwater site in Timor-Leste and Nusa Tenggara, supporting at least 50 waterbird species including large populations of ducks and rails. It is an important staging site for Oriental Pratincole *Glareola maldivarum* (c.3,000 recorded in November 2004); (2) Tasitolu is a site of high national biodiversity significance with 53 waterbird and coastal seabird species recorded from its saline lakes and mudflats; (3) Kupang Bay in West Timor is the most significant site for migratory waders in Nusa Tenggara. Regular monitoring of key sites and further fieldwork are needed, especially along the south coast (Covalima, Manufahi and Manatuto districts).

**1999**

Tomek T. 1999. The birds of North Korea. Non-Passeriformes. *Acta Zoologica Cracoviensia* **42**, 1-217.

(Abstract)

The occurrence of all, i.e. 220 species of birds of the group Non-Passeriformes in North Korea is presented on the basis of complete literature, most of the existing collections and the author's own unpublished observations. The dates and sites of observations recorded so far and maps illustrating the situation of these places are given for each species. The species are also provided with commentaries, in which their status in North Korea is discussed against their occurrence in the Far East. The species found in North Korea include, among other taxa,

those whose world populations are characterized by small sizes and are endangered or vanishing (e.g. *Egretta intermedia*, *Egretta eulophotes*, *Ciconia boyciana*, *Nipponia nippon*, *Mergus squamatus*, *Grus japonensis*, *Grus vipio*, *Eurynorhynchus pygmeus*, *Larus saundersi*, *Dryocopus javensis*). Data presented show that the boundaries of the breeding grounds (*Anas platyrhynchos*, *Accipiter soloensis*, *Accipiter gularis*, *Cuculus fugax*, *Halcyon pileata*) and those of the wintering areas of many species (mainly members of the orders Anseriformes and Charadriiformes) extend across North Korea. Moreover, the standard measurements (length of wings, tarsus, bill and tail) of birds collected in the territory of North Korea are given.