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PERSPECTIVE

Do 50-year-old Ramsar criteria still do the best possible job? A plea for broadened scientific underpinning of the global protection of wetlands and migratory waterbirds

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Abstract

With its focus on wetlands, the Ramsar Convention provides the clearest global agreement helping the conservation of migratory waterbirds. Two specific criteria (5 and 6) support the scientific basis for sites to achieve Ramsar recognition based on waterbird counts, while criterion 4, on species and ecological communities, also plays a role. Other international conventions and agreements follow these criteria. We identify several reasons why the listing thus established can only "catch" the absolute minimum wetland network for the conservation of migratory waterbirds. We argue that individual tracking and modern observational tools allow to better delineate the areas needed to effectively give migratory waterbird populations full life cycle protection. The sophisticated techniques to measure population characteristics now available should be used to modernize the guidance for the application of Criteria 4 and 6 of the Ramsar Convention for waterbirds, based on (i) time spent in a site throughout migration; (ii) critical ("untouchable") sites; (iii) robustness of designated site network including buffer areas; (iv) full life cycle information—including early life phases; and (v) refuges used on-and-off during migration in emergency situations. In these enhanced ways, migratory waterbirds can enact their roles as effective sentinels of the ecological state of the world.

KEYWORDS

buffering areas, conservation agreements, emergency refuge sites, life cycle, miniaturized technology, oversummering, timing

The Ramsar Convention on Wetlands of International Importance, especially as waterfowl habitat, is an international biodiversity convention focusing on the wise use of wetlands from 1971 (Bridgewater & Kim, 2021a, 2021b). During the historic meeting in the Iranian town of Ramsar, the value of waterbirds and the wetlands they rely on was, still rather implicitly, acknowledged as being fundamental to maintain healthy global ecological processes (Stroud et al., 2022). Subsequent conventions such as those on the Protection of the World Cultural and Natural Heritage (Paris 1972), CITES (Washington 1973), Migratory Species (Bonn 1983), and Biodiversity (Río de Janeiro 1992) all included criteria for the conservation of migratory birds based on the Ramsar criteria.

In spite of all these international conventions in force throughout several decades, with human numbers and living styles expanding in nonlinear ways, important areas enabling migratory birds to thrive have become more and more restricted to what became "formally" protected areas or lands under indigenous authority. In North America alone, this was associated with a net loss of 29% of bird abundance from 1970 to 2017, equivalent to 3 billion birds disappearing from the face of the Earth (Rosenberg et al., 2019). In a recent plea for a "Global Safety Net" to reverse biodiversity loss and stabilize the Earth's climate (Dinerstein et al., 2020), it was suggested that beyond the 15% land area currently protected, another 20% (or a total of 35%) of land area will actually be required to conserve biodiversity and stabilize climate. In addition to this classical "land sparing" approach, properly managed agroecosystems may critically aid to achieve these ambitious but urgently needed goals by "land sharing" (Fisher et al., 2014). To achieve Aichi Target 11 within the Convention on Biological Diversity, Garibaldi et al. (2020) proposed that at least 20% native habitat are needed in "working landscapes" (i.e., agroecosystems sensu lato).

Both the sparing and sharing approaches would work synergically for biodiversity conservation, particularly for migratory bird populations that need good habitat quality at geographically disjunct areas with very different socioeconomic and political situations (Fisher et al., 2014). Indeed, after more than five decades of international, national, subnational, and local conservation efforts, just 9% of 1451 migratory bird species are adequately covered by protected areas across all stages of their annual cycle (Runge et al., 2015). This compares unfavorably with the 45% of nonmigratory, resident species that are covered by protective measures (Runge et al., 2015). Among the migratory populations, the waterbirds fully rely on wetlands to complete their annual cycle. Alarmingly, as of 2009 the world had lost 33% of its wetland area mainly due to agriculture and urbanization (Hu et al., 2017), both of which need extensive catchments and regional groundwater extraction so vital to maintain the ecological character of wetlands too (Kingsford et al., 2021). In view of the specifics of their lifestyles (Piersma & Baker, 2000), the global situation is especially worrying for long-distance migratory shorebirds (Rosenberg et al., 2019). Hence, in an attempt to halt the declines of such key components of biodiversity (Bauer & Hoye, 2014), improvements of current conservation frameworks for migratory animals will be necessary (Fisher et al., 2014; Wilcove & Wikelski, 2008), particularly for those relying on wetlands. Our suggestions to follow complement the proposal by Bridgewater and Kim (2021b) that the Ramsar Convention, to become more effective, should reassert its original mandate and narrow its increasingly wide focus to the global protection of wetlands important for waterbirds.

With this focus on wetlands, the Ramsar Convention, now ratified by 171 countries, even today provides the clearest basis for the conservation of migratory waterbirds (Bridgewater & Kim, 2021a, 2021b; Stroud & Davidson, 2022). The Ramsar Convention currently lists more than 2400 wetlands of international importance that together cover 2.5 million km^2 (Bridgewater & Kim, 2021a). Wetlands recognized as Ramsar sites represent 16.8% of the maximum estimate of 14.9 million km^2 of remaining wetland areas on Earth (Hu et al., 2017). For an area to obtain Ramsar status based on waterbirds, one of two specific criteria need to be fulfilled: "*Criterion 5: … if it regularly supports 20,000 or more waterbirds*" and "*Criterion 6: … if it regularly supports 1% of the individuals in a population of one species or subspecies of waterbird*." In addition, a criterion based on species and ecological communities also applies to waterbirds: "*Criterion 4: … if it supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions*." Whilst the Ramsar Convention lists a total of nine criteria for site designation, up to 1616 sites have been designated because they fulfil (at least) one of the two specific criteria for waterbirds (Stroud & Davidson, 2022). Further, some of the sites inscribed on the World Heritage List sites (UNESCO) due to Outstanding Natural Values (e.g., the Diawling–Djoudj protected areas, the Pantanal, the Wadden Sea), as well as the sites identified by the Convention of Migratory Species and other international agreements and institutional arrangements (e.g., African–Eurasian Waterbird Agreement, East Asian–Australasian Flyway Partnership, Western Hemisphere Shorebird Reserve Network), base recognition on the two criteria specifically related to waterbird populations.

Simultaneous counts of birds using binoculars (in early times) and with the help of spotting scopes (more recently) were the only scientific tools to study the distribution of waterbirds during the nonbreeding season. Once systematically repeated at a given wetland to account for

TABLE 1 Ecological basis to develop additional guidelines for the application of the Ramsar criteria for the conservation of migratory waterbird populations throughout the annual cycle

Context	Rationale	Conservation mismatch	Examples	
			Taxa	Reference
Individuals do not occur regularly in large concentrations during migration (or belong to a species with very few individuals)	Critical staging and stopover wetlands will hardly ever reach 1% based on the maximum number observed at a given site during a given period	Many important wetlands unrecognized	*Calidris tenuirostris*, *Calidris pygmaea*	Chan et al., 2019 Bradfer-Lawrence et al., 2021
Individuals occur regularly in large concentrations during migration but remain invisible for coordinated waterbird counts	Large wetland areas in both hemispheres (especially southern) have never been prospected during migration	Several important wetlands unrecognized	*Limosa haemastica*, *Gallinago media*	Senner et al., 2014 Lindström et al., 2016
Immature individuals represent a small fraction of migratory waterbird populations	Critical wetlands during early life will hardly ever reach 1% based on the maximum number observed at a given site during a given period	Neglected oversummering phase (reducing effective recruitment rate)	Migratory species showing delayed maturity	Navedo & Ruiz, 2020 Martínez-Curci et al., 2015
Individuals occasionally occur in large concentrations during migrations	Wetlands to account for high uncertainty under global change will hardly ever reach "regularly" 1%, but occasionally surpassed 5%	Emergency refuge sites missed	All migratory waterbird populations	Shamoun-Baranes et al., 2010 Overdijk & Navedo, 2012

natural interannual variations, such counts inform about how many waterbirds occur "regularly" at a given site at a given time and so establish whether Criterion 5 is fulfilled or not. By adding up the counts within each flyway, it also provides the basis for estimates of overall population size of each species. Based on the fraction (of the total population thus derived), the numbers counted at each site are used for assessing Criterion 6 (e.g., van Roomen et al., 2012). What we argue here is that the resulting list of protected sites should be viewed as the absolute minimum wetland network for the conservation of migratory waterbirds. There are several quantitative and qualitative reasons for which the list is incomplete (Table 1).

1 | WHY THE APPLICATION OF RAMSAR CRITERIA FOR WATERBIRDS FALL SHORT OF THEIR AIMS

First, individuals located at wetlands not covered by simultaneous counts done at one time of the year (usually the northern hemisphere winter) are missed. In fact, in each flyway there are huge coastal and inland areas that are only partially covered, especially (though not exclusively) in the southern hemisphere. As a remarkable example, in a study on the globally "Endangered" great knots *Calidris tenuirostris* tracked from a nonbreeding site in northwest Australia, Chan et al. (2019) recently discovered that not a single one of the nearly 30 wetlands used by great knots during stopovers in Southeast Asia (mainly Indonesia) was even once surveyed, let alone recognized and protected. Further, a vast inland area of more than 28,000 km^2 was recently discovered in the southern cone of South America, where several different migratory waterbird populations—both Nearctic and Neotropical species—spend the austral winter in wetlands that have never been surveyed during such simultaneous counts (Navedo & Ruiz, 2020).

Second, wetlands of all sizes and spatial configurations have a single category within the Ramsar Convention, either having one or more species that fulfil Criterion 6 (the "so-called" 1%) or having one order of magnitude higher relevance for a given population (i.e., >10%). A critical example is provided by the many areas within the Yellow Sea (China, North and South Korea) that together form a migratory hub (Barter, 2002). Most of the separate sites would fulfil either or both of the Ramsar criteria on their own.

Third, the importance of sites based on a unique simultaneous count may be underestimated simply because the populations at the sites show big population turnover (for

just one example, see the study on ruffs *Calidris pugnax* in a Dutch staging area by Vervoort et al. [2022], where half the marked birds stage for a single day, but some individuals many weeks).

Fourth, the current approach to monitor population abundances for the detection of population trends (e.g., Amano et al., 2018; van Roomen et al., 2012) has demonstrated that they fall short of the aim at guaranteeing protection. Notably, at least two long-distance shorebirds of the genus *Numenius* (*N. borealis* and *N. tenuirostris*) are extinct (Pearce-Higgins et al., 2017), despite their classification as Critically Endangered, and even though some wetlands have been assigned Ramsar status because they were used by these (and other) waterbird species. That the equally Critically endangered spoon-billed sandpiper *Calidris pygmaea* may yet evade this fate will not be due to the evidence collected by winter counts, but by the proactive conservation measures enabled by satellite tracking of individuals helping the identification of key sites (Chang & Clark, 2018; Green et al., 2018), in combination with targeted efforts on the breeding grounds.

As a fifth concern, waterbirds are faced with many aspects of global change, either climate change or wetland shrinking due to water deprivation in their many different forms (Hu et al., 2017). For example, shorebirds making long-distance nonstop flights have to cope with serious physiological demands during migration (Piersma et al., 2022). The current destabilization of global circulation patterns (i.e., position of climate cells) lead to more unusual environmental conditions, for example, increases in the frequency of events such as El Niño/La Niña Southern Oscillation (Timmermann et al., 2018). It seems likely that increases in the frequency of strong (and aberrant) climatic events en route will necessitate migrants to make emergency stopovers, thus searching for refuges more often (e.g., Shamoun-Baranes et al., 2010). This means that under global change, some wetland areas that provide suitable environmental conditions for individual shorebirds or other waterbirds such as Eurasian spoonbills *Platalea leucorodia* (Overdijk & Navedo, 2012), but are not necessarily much used as regular stopover sites during migration for other reasons, would be critical for survival under current times of accelerated global change. Such "emergency refuge areas" will need detection and thereafter formal recognition to enable international protection.

2 | NECESSITY TO EXPAND THE GUIDELINES FOR THE APPLICATION OF THE CRITERIA

Establishing an adaptive management framework to track the ecological character of wetlands of international importance is key to improve conservation outcomes (Kingsford et al., 2021). Inspired by Green et al. (2017) and Dinerstein et al. (2020), and striving to a better use of the precautionary principle when managing endangered species (Prato, 2005), the added uncertainties coming from current climate change patterns, and the ongoing effects of intense human land use (Caro et al., 2022), we propose to reinforce the network of well-protected and managed wetlands. This should help halt the general long-lasting declines in migratory waterbirds as key components of global biodiversity (Bauer & Hoye, 2014). Obviously, the many technologies to follow movements of individual migratory waterbird species throughout the life cycle (Jetz et al., 2022) should be put to good use as critical information tool.

There is a need to expand the geographic delineation of internationally important wetland designations for waterbirds (Choi et al., 2019) and include surrounding land connected by land-use and hydrological processes as buffering areas for each site. The paramount wetlands designated as World Heritage Sites already make provision for buffer zones, but even for these "jewels" a more ambitious agreement is needed to avoid political decisions to hamper their Outstanding Natural Values. A clear example emphasizing this requirement is the Doñana area, in Southwest Europe, once declared the "crown jewel" for migratory waterbird populations within the East Atlantic Flyway and boosting a wave of biodiversity conservation culture in Europe. As recently recognized by the Court of Justice of the European Union (in a sentence condemning Spanish state, June 2021), Doñana continues to be severely threatened due to unregulated groundwater pumping for agricultural intensification (Camacho et al., 2022; Navedo et al., 2022). This land-use change is responsible for withdrawing water from both wetlands within the core Biosphere Reserve and, even more importantly, changing the surrounding agroecosystems from alternative wetlands such as rice fields where waterbird populations thrive to forage (Green et al., 2017) to other crops without value for waterbirds.

As a final remark, in establishing Global Safety Nets, it is critical that threatened migratory species need networks of sites to maintain a minimum ensemble of priority habitats to populations to complete their full annual cycle (Iwamura et al., 2013; Xu et al., 2022). Importantly, such networks should include sites mainly used by young, immature birds—as well as by some adults that skip a breeding attempt—that do not migrate to breeding grounds, a stage within the annual cycle called "oversummering" that in some long-lived species may last up to 3–4 years (Navedo & Ruiz, 2020). As an example, Tavera et al. (2021) show how the added survival of both juvenile and adult oversummering sandpipers compensated for the foregone breeding opportunities.

3 | A PLEA FOR A NEW CONSERVATION AGENDA FOR MIGRATORY WATERBIRDS

The global situation is very different from what it was 50 years ago, that is, when most international conventions dealing with natural values were designed and signed (Bridgewater & Kim, 2021a). The bulk of the debate and development of Ramsar criteria took place in Conferences of the Contracting Parties (COPs) and interseasonal sessions from 1971 to 1996. Since COP7 in 1999, with the unique exception of a ninth criterion included during COP9 in 2005, the focus has been on the interpretation of the application of the criteria through formal guidance, delivered by iterations of the Strategic Framework (Stroud & Davidson, 2022). During these five decade, the tagging of waterbirds with unique individual combinations of color or coded rings/flags allows the inference of population features through advanced capture–recapture analyses (Vervoort et al., 2022), and miniaturized technologies allow deep analyses of spatiotemporal use of wetlands even in remote geographical areas thanks to the use of available movement data repositories (see Jetz et al., 2022; Xu et al., 2022). In addition, by accurately filtering and further processing abundance data entered by citizens through apps (e.g., eBird; Johnston et al., 2021), relative site use during migration at the flyway scale may now be described for many species. Therefore, by applying the best available knowledge and adhering to the precautionary principle (Prato, 2005), we propose to enlarge the current minimum wetland network protected for waterbirds by means of updating the guidelines for the application of Criterion 6 of the Ramsar Convention as follows (see also Table 1): (i) include TIMING (e.g., 10% time) by means of percentage of time-tagged individuals of a given sample using a given area throughout migration; (ii) establish a set of CRITICAL sites (e.g., regularly support 10% or more individuals) for each assessed population, or 1% or more individuals of different species (e.g., three species) at each Flyway; (iii) add BUFFER areas surrounding designated sites, such as commuting, supplementary, or complementary habitats, most of them anthropogenic wetlands, regularly used (e.g., 30% time) by target species. In addition, guidelines for the application of Criterion 4 of the Ramsar Convention should include (as currently detailed for molting areas for Anatidae) (iv) EMERGENCY REFUGE sites that provide shelter (5% or more individuals of a given population in a given site, or 5% or more of tagged individuals of a given population using a given area during migration) and (v) specifically consider the fragile early life phases (including oversummering) as critical stages of migratory waterbirds LIFE CYCLE (e.g., regularly support 0.5% or more individuals during these stages).

Building on Bridgewater and Kim (2021b) about the role of International Organization Partners within the Ramsar Convention, we urge the worldwide conservation community to take more responsibility (than what is currently the case) to help empower existing and new scientific consortia to play the necessary active roles in developing (e.g., with the help of bird-tracking studies in relation to land-use and habitat quality) and then maintaining and curating the dynamic databases necessary for the criteria to do their work.

Summing up, despite all the good things that the Ramsar Convention has done for the recognition and protection and sustainable management of wetlands of international importance and the waterbirds relying on these wetlands over half a century, in view of (a) the fast changes in global environmental conditions and (b) the technical advances (of tracking, remote sensing) enabling much more comprehensive assessments of the critical aspects of waterbird biology, it is now at risk of becoming stagnant water if it ignores these factors. As recently highlighted in a review about the historical development of Ramsar criteria (Stroud & Davidson, 2022): "*amending the criteria themselves has been a pragmatic way of building meaning and interpretation while leaving the legally sensitive criteria unchanged (and avoiding the complex implications of amending the basis on which current Ramsar sites have been selected and legally designated)*." To move forward, after COP14 in 2022, we encourage the Scientific and Technical Review Panel of the Ramsar Convention to review, analyze, discuss, and develop guidance for the interpretation or application of these two criteria throughout interseasonal sessions before COP15 (foreseen in 2025) when an updated Strategic Framework could be ratified followed by a resolution. This updated guidance will support strategic goal #2 of the *Ramsar Strategic Plan 2016–2024*: "*effectively conserve and manage the Ramsar Site Network*" (Ramsar Convention Secretariat, 2016). We propose concerted efforts to modernize the ways we evaluate and protect the world's scarce wetland habitats, also because their function for climate change mitigation purposes by blue-carbon sequestration. We believe that an invigoration of the role of migratory waterbirds as effective sentinels of the state of the world shouts out to be the basis of this effort.

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