Defining waterbird populations and delineating them

Internal guidance for regional coordinators reviewing population estimates, trends and defining population boundaries

By Szabolcs Nagy, 27 April 2020

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Introduction

This document has been drawn up based on the author's experience working with waterbird populations in the context of Agreement on the Conservation of Migratory Waterbirds in Africa-Eurasia (AEWA). Over the last four decades a high level of conceptual development for flyway definition has been made under the framework of AEWA. Therefore, the document uses examples mainly from the African-Eurasian flyway and refers extensively to the guidelines developed by the AEWA Technical Committee.

Which 'populations' of waterbirds are included in the Waterbird Population Portal?

The aim of the Waterbird Population Portal to support the identification of key sites for waterbirds under the framework of the Ramsar Convention on Wetlands and under the flyway instruments. Paragraph 88 of the Ramsar Convention's Strategic Framework and guidelines for the future development of the List of Wetlands of International Importance of the Convention on Wetlands (Ramsar, Iran, 1971) states that "*... the presence of introduced or non-native species should not be used to support a case for designating a site as a Wetland of International Importance*" (Ramsar Convention, 2012, pp. 10-11). According to the AEWA Technical Committee (2016b) non-native species are not subject to the conservation regime of AEWA. Therefore, introduced or non-native populations are only listed in the Waterbird Population Portal if they are recognised by the relevant flyway instrument.

Resident populations of (re-)introduced populations are only recognised if they are recognised as a native species by the official checklist of the country.

What is a waterbird biogeographical population?

The Waterbird Population Portal aims to support the Ramsar Convention on Wetlands and various flyway instruments. However, it is inappropriate to treat a species with very large range[1] as one population for conservation and management purposes:

- 1% thresholds for site selection will be so high that it will be impossible to identify and protect key sites for them and
- Management requirements will be fundamentally different in different parts of the range.

Therefore, the Waterbird Population Portal uses the biogeographical population concept[2] adopted by the Ramsar Convention (2012) based on the works of Atkinson-Willes *et al.* (1982). This approach was applied in delineating waterbird populations in the African-Eurasian flyway (Delany, Scott, Dodman, & Stroud, 2009; Scott & Rose, 1996) and in all earlier editions of the Waterbird Population Estimates.

The concept was critically reviewed and simplified by the Technical Committee of the Agreement on the Conservation of African-Eurasian Migratory Waterbirds (2005):

A waterbird biogeographical population is a population of a species or a sub-species that is either geographically discrete from other populations at all times of the year, or at sometimes of the year only, or is a specified part of a continuous distribution so defined for the purposes of conservation management.

This concept is depicted in Figure 1 and illustrated with some examples below:

1. Monotypic species with a single population: e.g. Red-breasted Goose *Branta ruficollis*[3];
2. Monotypic species with several populations that are discrete all year around: e.g. Pink-footed Goose *Anser brachyrhynchus*[4];
3. Populations of a monotypic species that are separate only part of the year: e.g. the breeding range Eurasian Wigeon *Mareca penelope*[5] overlaps, but there are five non-breeding populations distinguished in Eurasia;

[1] It is also important to note that the IBA inventories of BirdLife International (Fishpool & Evans, 2001; Heath, Evans, Hoccom, Payne, & Peet, 2000) use the term 'biogeographic population' in the sense of a zoogeographic realm, e.g. Palearctic or Afrotropical realm, and all 'populations' of a given species that are resident or migratory through the region are combined to form the 'biogeographic population'. However, these units are usually much larger than the biogeographical populations recognised by the Ramsar Convention and other flyway instruments.

[2] The meaning of the biogeographical population as applied in the context of the Ramsar Convention and the Waterbird Population Portal differs from the one used by BirdLife International

[3] http://csn-tool.herokuapp.com/en/species/22679954

[4] http://csn-tool.herokuapp.com/en/species/22679872

[5] http://csn-tool.herokuapp.com/en/species/22680157

4. Regional group of a monotypic species with continuous distribution: e.g. West Africa, Eastern & Southern Africa and the Madagascar 'populations' of White-faced Whistling-duck *Dendrocygna viduata*[6];
5. Subspecies of a polytypic species with a single population: e.g. Red-chested Flufftail *Sarothrura rufa*[7];
6. Subspecies of a polytypic species with several populations that are discrete all year round: e.g. the Canada & Greenland/Ireland and the Svalbard/Denmark & UK populations of Brent Goose *Branta bernicla hrota*[8];
7. Populations of one or more subspecies of a polytypic species that are separate part of the year only: e.g. the wintering grounds of the populations of Dunlin *Calidris alpina*[9] overlap, but have separate breeding grounds;
8. Populations of one or more subspecies of a polytypic species with continuous distribution: e.g. Greylag Goose *Anser anser*[10] .

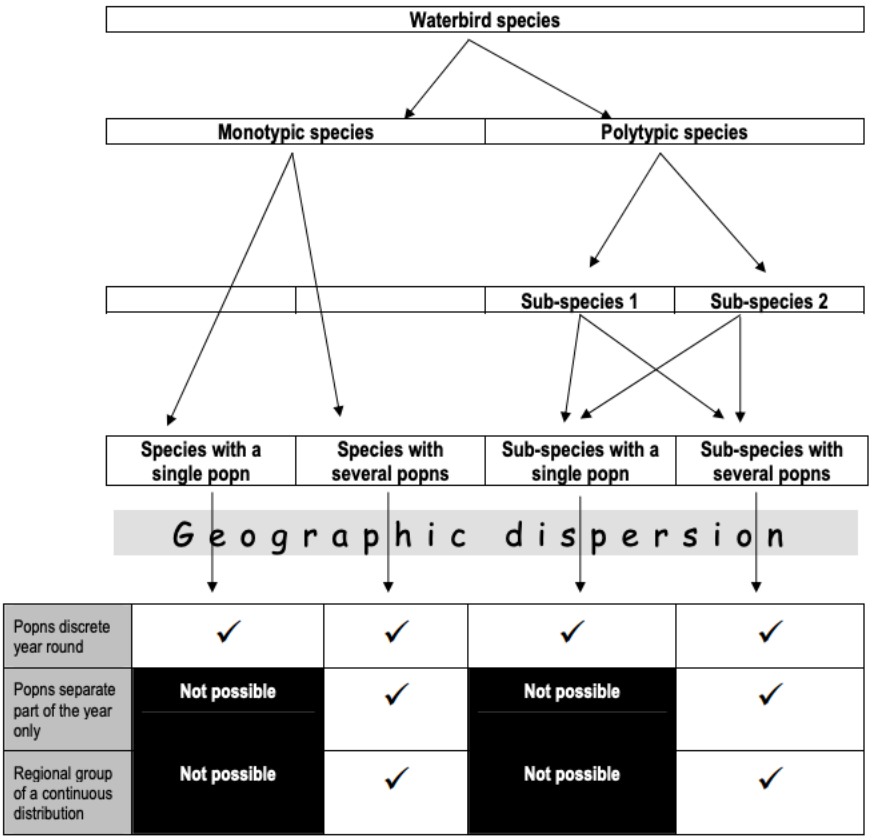

Figure 1. The basis for defining different types of biogeographic populations based on AEWA Technical Committee (2005).

An important consequence of the above definition is that **one biogeographical population may consist of only one subspecies**. Based on this requirement, Whimbrels *Numenius phaeopus*[11] spending the on-breeding period in West Africa cannot be considered as one biogeographic population as they were in WPE1 and WPE2 based on Smit and Piersma

[6] http://csn-tool.herokuapp.com/en/species/22679763
[7] http://csn-tool.herokuapp.com/en/species/22692223
[8] http://csn-tool.herokuapp.com/en/species/22679946
[9] http://csn-tool.herokuapp.com/en/species/22693427
[10] http://csn-tool.herokuapp.com/en/species/22679889
[11] http://csn-tool.herokuapp.com/en/species/22693178

(1994) because individuals from the *islandicus* and the nominate race are mixing on the non-breeding areas. Therefore, from WPE3 onwards, they have been separated into two populations.

For the practical application of the biogeographical population concept, it is important to note that these are rarely true biological populations:

- Cases 1-2 and 5-6 are the closest to the biological population concept while 3-4 and 7-8 can be best considered as being equivalent to a management unit.
- In case of 3 and 7, the separation can be made based on their discrete breeding or non-breeding areas.
- In case of 4 and 8, the large continuous distribution can be divided into regional groupings both for migratory and sedentary species.
    - The range of such species should be divided first based on the distribution of subspecies following del Hoyo *et al.* (2016) and its updates in HBW Alive (del Hoyo, Sargatal, Christie, & Kirwan, 2020);
    - Then it might be further divided by well-recognised biogeographic regions (e.g. NW Europe and Mediterranean in Europe or West and East Africa) as a practical approach to define management units that produce meaningful 1% thresholds.
    - Atkinson-Willes *et al.* (1982) recognised the problem that might arise from using such biogeographic regions when a species is abundant in one region but scarce and at the edge of its range in the next. If the two regions were treated separately, the 1% criterion would place an undue emphasis on sites in the less important region. Therefore, they proposed to combine the two regions or to amend the boundary between them, so the marginal overspill is included in the main population. This might be especially important in areas that were treated traditionally separately such as South Asia and Southwest Asia. However, it is important to distinguish between small relict populations that are geographically (and maybe even genetically) isolated from the main population. In such cases, it is justified to treat them separately. An example for the former is the formerly separate Southern Asia population of Sociable Lapwing *Vanellus gregarious*[12] with only 200 individuals that was merged with the much larger SW Asia & NE Africa population (AEWA Technical Committee, 2016a, pp. 8-9). An example for the latter is Central Western European and Balkans breeding populations of Goosander *Mergus merganser*[13].
    - These delineations should be guided not only by biological but also by practical monitoring and management considerations. For example, the White-tailed Lapwing *Vanellus leucurus*[14] used to have two wintering populations: one in South-west Asia & North-east Africa and another one in Southern Asia (Delany et al., 2009, pp. 175-178). Both populations breed in Central Asia and there are some additional breeding areas in SW Asia. As it is fairly dispersed both during the breeding and the wintering season, it was only possible to provide very rough estimates for both populations: 10,000 – 25,000 and 10,000 – 100,000 individuals respectively. Considering the dispersed wintering distribution of the species, there is no prospect of improving on

[12] http://criticalsites.wetlands.org/en/species/22694053
[13] http://criticalsites.wetlands.org/en/species/22680492
[14] http://csn-tool.herokuapp.com/en/species/22694053

these estimates based on mid-winter counts. However, it might be possible to produce population estimates for the entire population based on sampling in the breeding range. Therefore, the two populations were merged (AEWA Technical Committee, 2016a, pp. 10-12).

- Considering sedentary island populations as separate biogeographical populations would lead to very small thresholds. In such situations, these smaller populations are best considered as part of a more extensive meta-population and treated as one biogeographical population unless they are very isolated from the rest of the subspecies considering the mobility of the species. E.g. the Mauritius, Reunion and Rodrigues population of the *javanica* subspecies Green-backed Heron *Butorides striata* is separated by more than 5,000 kilometres from the nearest range of the subspecies in SE Asia. Therefore, it has been separated.

It has been recognised that biogeographical populations are not static. Their range and migratory behaviour may change due to a number of factors. Therefore, the AEWA Technical Committee (2016b) has developed the following guidance for reflecting population changes in their treatment:

1. Fragmentation of existing population: Treat the population as a distinct population;
2. Translocation within the native range: Treat the population as part of the existing population, or in the absence of an extant population, as part of a historical population;
3. Translocation (partially or completely) outside of the existing range: Treat as a separate population if the translocation has been carried out in accordance with the relevant translocation guidelines;
4. Newly established as a result of natural process: Treat it as a separate population if it has distinct breeding or non-breeding areas OR treat as part of the original population if it has no distinct breeding/(non-breeding) areas;
5. Newly established as a result of unintended introduction: Should be not recognised;
6. Formerly separate/fragmented populations have merged into a continuous population: Treat as one population applying the definition outlines above.

What areas to include into the population boundaries?

Defining population boundaries should be given by the range definition of the Convention on Migratory Species (Article I.1.h):
"*Range means all the areas of land or water that a migratory species inhabits, stays in temporarily, crosses or overflies at any time on its normal migration route*".

As it is also stated in the flyway definition for populations, the range includes the breeding, moulting and non-breeding and all areas passed between these. This range definition is also applicable to sedentary or dispersive species and their populations.

The important thing is that the population boundaries should encompass the areas where the species normally occurs, and vagrants should not be included into the range of the population. However, areas used during cold or dry weather movements should be included because using those areas is part of the species ecology.

Marking, tracking and stable isotope studies as well as observational data (Important Bird and Biodiversity Areas[15] for the species, International Waterbird Census (IWC) data, online observation portals such as eBird[16], Observation.org[17]) can be used to get an idea of the distribution of the population, but care should be taken to distinguish regular occurrence from vagrancies. Undetected misidentifications or data entry errors might be also a risk. Unfortunately, it is not possible to use a universally applicable threshold for vagrancy because this very much depends on the number, equipment and training of birdwatchers in a country and also on the population size of the species in question. There are many North American species occurring in Western Europe almost annually, but these are still considered as being vagrants. Checklists can assist judging whether a species is a vagrant in a given country. It is suggested to give priority to the national checklists when judging the status of a species in a country. If no national checklists are available or readily accessible, the following more general checklists can be of use:

- BirdLife Data Zone[18] > search for the species > Data table and detailed info > Country/territory distribution table: look for the N: native occurrence status[19];
- Avibase[20] > search for a species or subspecies > map.

Delineating the pelagic range of species presents major challenges because they might remain under-recorded in the pelagic parts of their range and areas beyond the Exclusive Economic Zone boundaries will be not covered by checklists. In such situation it is suggested to use the ranges from the distribution maps of BirdLife International unless there is any solid observational or tracking evidence to the contrary.

Existing population boundaries for populations of African-Eurasian species in the Critical Site Network Tool were drawn using one of the following two approaches (or a mixture of them) to express uncertainties in delineations[21]:

- Overlap between the ranges of the populations indicated with overlapping boundaries, e.g. Common Ringed Plover *Charadrius hiaticula* in Delany *et al.* (2009, p. 197), or
- The overlap areas were separated by dashed lines, e.g. Little Ringed Plover *Charadrius dubius* in Delany *et al.* (2009, p. 203).

It is important to bear in mind that the aim of the delineation of biogeographic populations is to assist conservation and management. Therefore, it is more important to capture the main distribution areas than including the exceptions.

Meininger *et al.* (1995) have suggested that when two or more populations use a site during the course of a year, the 1% threshold used at a particular time of year should be the 1% threshold of that population which is most abundant at that time of year. When it is unclear which population dominates, the highest level should be applied. High level of overlaps

[15] BirdLife Data Zone > search for the species > Data table and detailed info > Important Bird and Biodiversity Areas table
[16] https://ebird.org/map
[17] https://observation.org/specieslist.php
[18] http://datazone.birdlife.org/species/search
[19] The information is compiled by the BirdLife International Partnership and it is known to have some omissions.
[20] https://avibase.bsc-eoc.org/avibase.jsp?lang=EN
[21] However, these details are not captured in the flyway boundaries presented on the CSN Tool.

between the ranges of biogeographic populations may hamper the ability of managers to identify which 1% threshold is applicable at the area.

Likewise, high level of overlaps would introduce also complications when trying to use the population delineations to produce population size and trend estimates.

Documenting population delineations

The AEWA Technical Committee (2005) has highlighted the importance of clearly documenting the evidence, the assumptions and the considerations behind the definition and the delineation of the populations. This is particularly important where knowledge is poor and there is limited hard data to support decisions as of the limits of populations. Scott & Rose (1996), Delany *et al.* (2009) and the *pro-formas* used by the AEWA Technical Committee (2016a, 2019) to justify proposals for changing population definitions provide good examples for such documentation.

As population delineation always effect more than one population, it is best to document population changes at regional (i.e. flyway or continental) level for the species. Scott & Rose (1996) and Delany *et al.* (2009) both used the same structure to document the considerations behind the population definitions:

- distribution and geographic differences;
- movements;
- population limits.

Uncertainties concerning the delineation of a population are usually heterogenous across the range. There might be parts of the range where there could be a lot of confidence in the delineations while in other parts very little is known. Usually, the western borders of the breeding range of European wader populations can be defined rather clearly, but there is much more uncertainty concerning the eastern borders. There is a high degree of mixing amongst individuals of duck and wader populations during the non-breeding season and in most cases the delineations of the population boundaries are based on practical monitoring and management considerations as much as on data. Transparency of such considerations can be ensured only if these are clearly described.

Recommended steps to review existing population boundaries

1. Look at the range map of the species from BirdLife International on Data Zone. A quick, low-tech solution is to make a screenshot of this map and insert it into a PowerPoint slide.
2. Obtain observational data for the species in your region from eBird, IWC, etc. and compare them with the range map. Check whether you can see any regular occurrences that are not included on the range map. If yes, note these on your PowerPoint slide.
3. Overlay existing population definitions over the data. You can just simply draw draft lines based on the description in PowerPoint using Insert > Shape > Curve. Alternatively, you can use Google Earth or QGIS. The advantage of the latter two is that the boundaries can be opened and modified by somebody else.
4. Obtain available ringing, tracking, stable isotope studies and compare them with the population definitions. Check whether there is any discrepancy between the data and the existing boundaries.

5. If the population overlaps with another region, coordinate with the other regional coordinator.
6. Based on the above propose modifications to the population definition: splitting, merging, changing the boundaries, etc.
7. Document the rationale behind the proposed changes. The AEWA Technical Committee (2016a) change proposal contain some good examples.

Case study: Great White Egret *Ardea alba* in Asia and Australasia

Distribution and geographic in Asia and Australasia

Great White Egret (GWE) occurs across Asia S from the latitude N° 53 to the tropical region and its range extends into Australasia. Wetlands International's taxonomic reference, the HBW Alive (del Hoyo et al., 2020), recognises two subspecies of Great White Egret in Asia and Australasia:

- *A. a. alba* – Western Great Egret –C Asia (S to Iran), Russian Far East, NE China (Heilongjiang) and C Japan; winters Persian Gulf to S China and Korea.
- *A. a. modesta* – Eastern Great Egret – Indian Subcontinent E to SE Asia, SE & E China, S Japan and Korea, S through Sundas, Wallacea and New Guinea region to Australia (except arid interior) and New Zealand.

Brazil (2009) specifies that the nominate race occurs north to Honshu and overshooting to Hokkaido in Japan, winters in Japan and Korea. The *modesta* subspecies breeds from Jilin to Fujian, to S Japan and Korea, wintering in Taiwan and S China.

Figure 2 shows the distribution of the two subspecies, recognised as two separate species by Heron Conservation (2020a, 2020b)[22]. Breeding season observations in the range of the nominate race seem to cluster in Xinjiang, Mongolia and S Central Siberia (Figure 2). There is another cluster of observations in Heilongjiang and the Russian Far East. The assignment of the population fragments in central Mongolia and Lake Baikal is uncertain. According to the eBird observations (Figure 3), the *modesta* subspecies is more widely distributed in China also during the breeding season than shown on Figure 2.

[22] However, major taxonomic authorities continue treating them as subspecies of Great White Egret. See the taxon grid on Avibase: https://avibase.bsc-eoc.org/species.jsp?lang=EN&avibaseid=267D8CCE889A4D6F&sec=taxontable

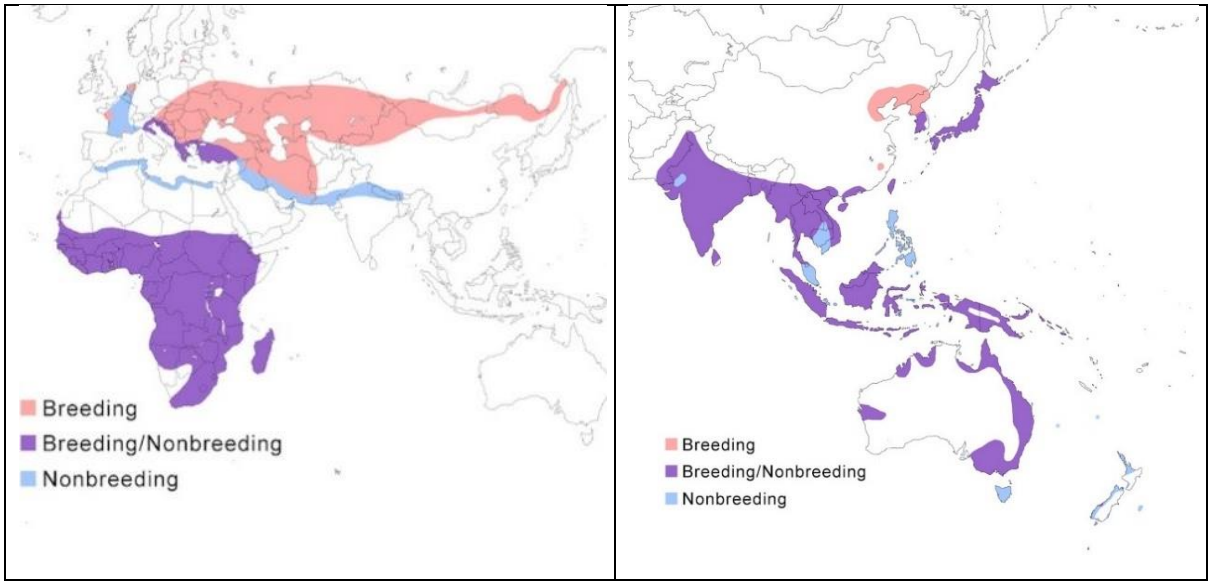

Figure 2. Distribution of the Western alba *(left) and Eastern* modesta *(right) Great White Egret in the Asia and Pacific regions based on Heron Conservation (2020a, 2020b). Note the range of the GWE does not include Central Japan on this map.*

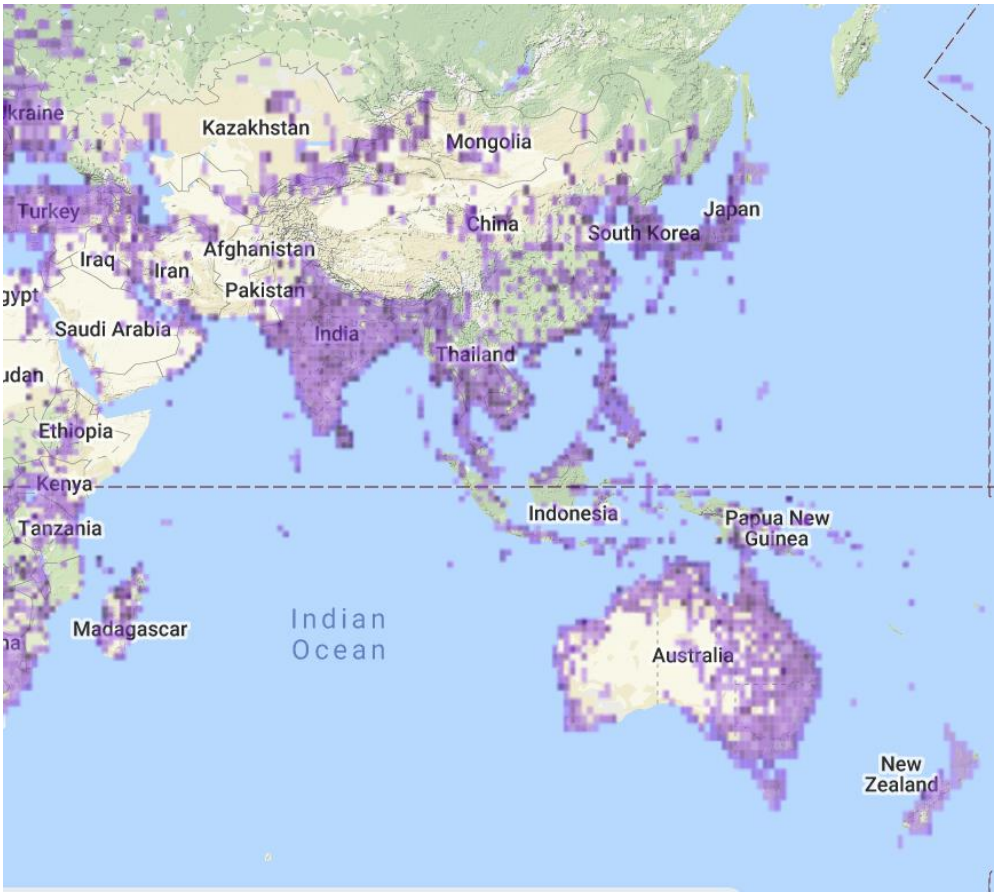

Figure 3. Observations of Great Egret in Asia and Australasia based on eBird[23]

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https://ebird.org/map/greegr?neg=true&env.minX=&env.minY=&env.maxX=&env.maxY=&zh=false&gp=false&ev=Z&mr=1-12&bmo=1&emo=12&yr=all&byr=1900&eyr=2020

Movements

Palearctic and Nearctic birds are partially migratory with some dispersive movements, tropical birds are generally sedentary. Individuals from the western cluster probably follow the migration route of other Great Egrets in Central Asia to the Persian Gulf and Pakistan. The *alba* subspecies migrate from N China through east and west China to south Tibet and south China (Heron Conservation, 2020b). The individuals of the *modesta* subspecies from E Asia move to SE Asia and Philippines (del Hoyo et al., 2020). Bird on the Indian subcontinent and in SE Asia are mostly resident. Australian populations generally dispersive, although some regular seasonal movements occur, which might be migratory; sometimes irruptive, e.g. moving from interior to coast during droughts; occasionally to New Zealand and New Guinea, with most records from Melanesia (New Britain, Solomons and New Caledonia) apparently also attributable to migrants from Australia. New Zealand population dispersive (del Hoyo et al., 2020). Dispersing birds occur on distant islands.

Population limits

The 5th edition of the Waterbird Population Estimates (WPE5, Wetlands International, 2012) distinguished the following populations in Asia and Australasia:

- *alba*, Western Asia/South-west Asia
- *modestus*, South Asia (non-bre)
- *modestus*, E Asia (non-bre)
- *modestus*, Indonesia
- *modestus*, Australia
- *modestus*, New Zealand

However, the non-breeding populations in S and E Asia consists of individuals from both subspecies and treating them as one non-breeding population violates the principle that a biogeographical population logically cannot include more than one subspecies. Therefore, the E Asia population should be split and new populations need to be defined based on breeding distributions. It is unlikely that the Indonesian population is separate from birds in neighbouring Malaysia. Non-breeding birds from different races and different populations are likely to mix extensively during the non-breeding season.

The following populations are suggested:

1. *alba*, Western Asia/South-west Asia: expand the boundaries of the breeding range of the existing population to the E to include Xinjiang, W Mongolia and the Altai and Tuva Republics in Russia. Possibly the wintering range of this population should be expanded to include birds of the nominate race in the range indicated in N India by Heron Conservation (2020b);
2. *alba*, *East Asia* (bre): the breeding range of this population would include SE Russia E from Tuva, Central and E Mongolia and Heilongjiang in China. The non-breeding range is highly uncertain, but includes E Asia, S China and S Tibet.
3. *modesta*, South Asia: mainly resident birds breeding in South Asia. In winter, they might be supplemented with birds from other populations.
4. *modesta*, E & SE Asia (bre): a partially migratory population breeding in E Asia and SE Asia. During the non-breeding season it might be supplemented with birds from other populations.
5. *modesta*, Australia, New Guinea and W Pacific islands E to Vanuatu.
6. *modesta*, New Zealand

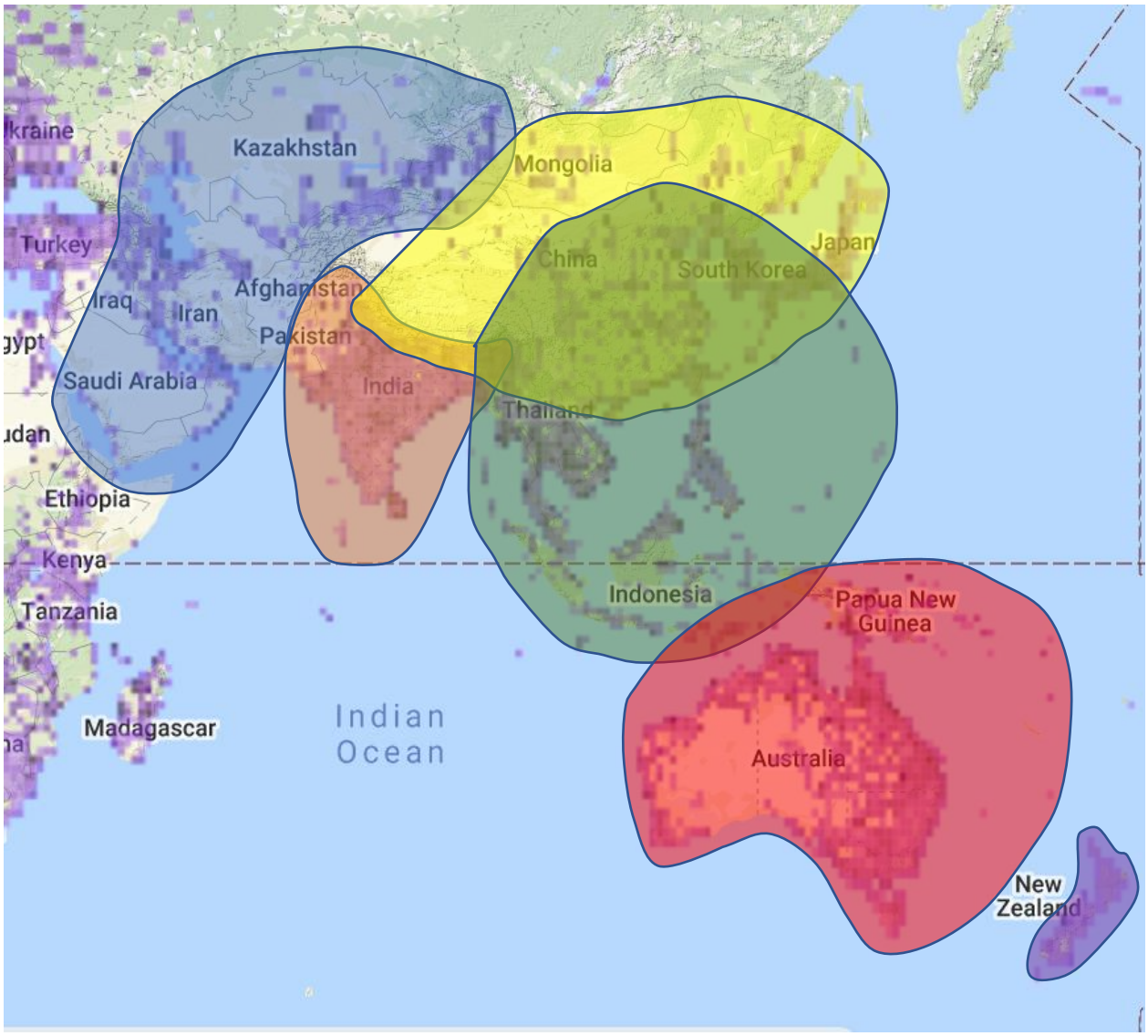

Figure 4. Proposed delineation of Great White Egret populations in Asia and Australasia. Blue: 1, yellow: 2, orange: 3, green: 4, red: 5 and purple: 6 above.

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