# [MOP9/D11] INTERNATIONAL ACTION PLAN FOR THE CONSERVATION OF THE SCALY-SIDED MERGANSER *Mergus squamatus*, 2016-2025 (SCALY-SIDED MERGANSER TASK FORCE)

EAAFP Scaly-sided Merganser Single Species Action Plan

This Single Species Action Plan has been prepared to assist fulfilment of obligations under:

**Convention on the Conservation of Migratory Species of Wild Animals (CMS)**

**East Asian – Australasian Flyway Partnership**

**Compiled by** Diana Solovyeva (Institute of Biological Problems of the North), Peter Cranswick & Baz Hughes (Wildfowl & Wetlands Trust).

**Contributors**

The following Task Force members either participated in the workshops in 2010 and 2015 or provided comments on the plan: Lei Guangchun, Peiqi Liu, Zeng Qing, Li Chengquan, Lu Kai, Lei Cao, Li Jing, Sergey Surmach, Vladimir Pronkevich, Sergey Vartanyan, Vladimir Bocharnikov, Andrey Averin, Nial Moores, Spike Millington, Ri Song Il, Ri Kyong Sim, Fang Woei-Horng, Johnpaul Houston, Colette Hall, Chuck Cerbini, Johnatan Slaght, Mark Barter, Antony Fox.

**Milestones in the Production of the Plan**

Action Planning Workshops: April 2010; September 2015.

First draft: September 2015.

Second draft: November 2016.

Final draft: January 2017, approved by EAAFP MoP 9.

**Geographical Scope**

This plan should be implemented in the following Principal Range States[4]: the Democratic People's Republic of Korea, the People's Republic of China, the Republic of Korea and the Russian Federation.

The species also occurs in small numbers in other countries/areas, including the Kingdom of Thailand, Republic of the Union of Myanmar, Japan, and Vietnam. Although there is no requirement for this plan to be adopted in these countries, they are encouraged to develop appropriate measures for the species based on the framework of this plan.

**Reviews**

This International Single Species Action Plan should be reviewed every ten years.

**Recommended Citation**

Solovyeva, D.V., P.A. Cranswick & B. Hughes. 2017. International Single Species Action Plan for the Conservation of the Scaly-sided Merganser *Mergus squamatus*. CMS Technical Series No. #, EAAFP Technical Series No. #.

**Cover Photograph**: Xiao Dongyang

For more information on Scaly-sided Mergansers, consult the EAAFP Scaly-sided Merganser website: http://www.eaaflyway.net/our-activities/task-forces/scaly-sided-merganser/

[4] Countries / areas are referred to in this plan as: China, DPRK, Myanmar, Japan, ROK, Russia, Thailand and Vietnam.

**SUMMARY**

The Scaly-sided Merganser *Mergus squamatus* is a globally threatened species, classified as Endangered on the IUCN Red List since 2002. This is justified on the basis that it has a very small population which is suspected to be undergoing a continuing and rapid decline as a result of habitat loss, illegal hunting and disturbance.

Based on surveys in the breeding range during 2000–2012, the population is estimated to be *c.* 1,940 pairs (or *c.* 4,660 birds prior to reproduction) (Solovyeva *et al.* 2014). This comprises 1,654 pairs in Russia (1,643 in the Sikhote-Alin), 166 pairs in China (155 in the Changbai Mountains), and an estimate of 116 pairs in DPRK (all in the Changbai Mountains).

The species is endemic to East Asia. The majority of the population (85%) breeds in the Sikhote-Alin mountain range in Far Eastern Russia (primarily in Primorsky Krai and Khabarovsk Krai). Most of the remainder (14%) is found in the Changbai Mountains, straddling China (Jilin Province) and DPRK, though there have been no recent surveys in the latter country to confirm its continued presence there. A small number of pairs (ca. 20) also breed in the Lesser Xingan Mountains in China. The species winters mainly in central mainland China, probably within the Yangtze River catchment and in small number on the Taiwan Island, and in the Republic of Korea. It also occurs in small numbers in other countries / areas, notably the Kingdom of Thailand, the Republic of the Union of Myanmar, Japan, Vietnam.

Scaly-sided Mergansers rely on freshwater rivers throughout the annual cycle. Breeding habitat requirements include mature broadleaf forest on the banks of clean fast-flowing rivers. It nests solely in tree cavities (or in artificial boxes and tubes designed to emulate natural nest sites). Scaly-sided Mergansers feed on various fish species, frogs and aquatic insect larvae on the breeding grounds. Ducklings rely on small fish and larvae.

In winter, almost all birds are found on rivers and freshwater reservoirs. Ideal winter habitat seems to be similar to that used for breeding: fast-flowing clean mountain rivers with a variety of fish. Modelling showed favoured habitats were rivers and reservoirs within an area with mid-winter air temperatures of above 2°C. Diet in winter is poorly studied but includes different fish species.

The main threats to the species, all of which are considered to be high (factor causing or likely to cause rapid and/or major decline) are poaching, drowning in fishing nets, dam construction affecting the suitability of rivers as feeding areas, and pollution.

The goal of the plan is to remove the Scaly-sided Merganser from the threatened categories of the IUCN Red List. The objective is to maintain the world population of Scaly-sided Merganser at its current level (*c.* 5,000 birds). To meet this objective, the plan sets out ten results to be achieved within its lifetime:

**Result 1**: Raise awareness of the issue of dams and reduce construction of new dams in sensitive areas.

**Result 2**: Reduce pollution in wintering areas.

**Result 3**: Raise awareness of the issue of dredging and reduce the impact of dredging in sensitive areas.

**Result 4**: Eliminate mortality from shooting in breeding and moulting grounds in Russia.

**Result 5**: Minimise drowning in fishing nets in breeding grounds.

**Result 6**: Minimise disturbance during brood-rearing period.

**Result 7**: Key knowledge gaps about the species and threats are addressed.

**Result 8**: A network of protected areas, covering all important sites throughout the lifecycle, is designated and maintained and supported by wider policies.

**Result 9**: Increase production of young through coordinated nest box programmes.

**Result 10**: Manage captive breeding populations in North America and Europe to maximise genetic diversity and establish a funding mechanism for zoos to support in situ conservation.

A total of 41 actions are identified to deliver the results.

Relevant authorities, statutory bodies and stakeholders are encouraged to work collaboratively to implement the actions. International cooperation and coordination will be essential. Progress towards both delivery of the actions and achievement of the results should be reviewed on a regular basis. Barriers to implementation should be identified and overcome to ensure that the objective of the plan is met.

## 1. PLAN PURPOSE

### 1.1 Purpose of this action plan

This plan specifies actions to improve the conservation status of the Scaly-sided Merganser *Mergus squamatus*. Experts from all range states, through a series of consultations, have identified the most important known or suspected threats to the species and determined actions to remove these threats or mitigate their effects. This approach has enabled unpublished data and expert opinion to be included in the development of the plan while retaining high scientific rigour.

Relevant actions should be implemented in each range state. Countries are encouraged to develop national work plans for the Scaly-sided Merganser, or to transpose these actions into existing plans and legislation.

Implementation will require the collaborative efforts of national and regional authorities and competent statutory bodies, and a range of key stakeholders. Principal among these are national and international non-governmental conservation organisations, hunting, game management and fishing organisations, site management committees, and academics.

International cooperation and coordination will be essential for implementation. This should be facilitated, in the most part, through the East Asian – Australasian Flyway Partnership Anatidae Working Group's Scaly-sided Merganser Task Force.

It is expected that the actions identified in this plan will receive priority consideration for funding through relevant international and national instruments.

The conservation of the Scaly-sided Merganser is dependent on the successful implementation of this Plan. Progress towards both delivery of the actions and achievement of the results should be reviewed on a regular basis. Barriers to implementation should be identified and overcome to ensure the objective of the Plan is met.

### 1.2 Geographical scope

This plan should be implemented in the following Principal Range States[5]: the Democratic People's Republic of Korea, the People's Republic of China, the Republic of Korea and the Russian Federation.

The species also occurs in small numbers in other countries / areas, notably Kingdom of Thailand, Republic of the Union of Myanmar, Japan and Taiwan Island. Although there is no requirement for this plan to be adopted in these countries, they are encouraged to develop appropriate measures for the species based on the framework of this plan.

Scaly-sided Merganser occurs as a vagrant in other countries within the EAAFP region. There is no obligation to implement this plan in those countries.

### 1.3 Plan term

This plan covers the period 2016 to 2025.

This plan should be reviewed and updated every ten years, with the next revision in 2025. An emergency review will be undertaken if there is a significant change to the species' status before the next scheduled review.

## 2. CONSERVATION OBLIGATIONS

Conservation obligations and requirements for Scaly-sided Merganser are specified in various international and national policies, legislation and agreements.

### 2.1 Global status

Scaly-sided Merganser is a globally threatened species, classified as Endangered on the IUCN Red List since 2002. This is justified on the basis that it has a very small population which is suspected to be undergoing a continuing and rapid decline as a result of habitat loss, illegal hunting and disturbance.

### 2.2 International conservation and legal status of the species

The East Asian – Australasian Flyway Partnership's (EAAFP) Implementation Strategy has the objective to 'develop, especially for priority species and habitats, flyway wide approaches to enhance the conservation status of migratory waterbirds and specifically identifies Scaly-sided Merganser as species for which an International Single Species Action Plan should be produced and implemented, to act as a flagship for wetland conservation.

**Table 1**. Applicability of major international conservation instruments to Principal Range States for the Scaly-sided Merganser.

[5] Countries / areas are referred to in this plan as: DPRK, China, ROK, Myanmar, Japan, Russia, and Thailand.

| Principal Range State | EAAFP | CMS | CBD | Ramsar |
|---|---|---|---|---|
| DPRK | No | No | Yes | No |
| China | Yes | No | Yes | Yes |
| ROK | Yes | No | Yes | Yes |
| Russia | Yes | No | Yes | Yes |

### 2.3 National policies, legislation and site protection

**DPRK**

The species is listed as an Endangered species in the 2016 Red Data Book of the DPRK. Earlier, the Red Data Book (DPRK 2002) stated that "Investigation on population and breeding should be done and habitat should be protected". However, initial discussions suggest that there has been little progress in conducting focused research on the species due to a range of challenges. Nonetheless, the National Biodiversity Strategy and Action Plan (DPRK 2007) recognised the issue of deforestation and habitat degradation and listed several protected areas which seem on present knowledge likely to include breeding habitat of the Scaly-sided Merganser. Especially, these include designation of 24,000ha of "Strict nature reserve" in core areas of the Baekdu Biosphere Reserve and an additional 36,000ha of buffer zone there.

**China**

Scaly-sided Merganser is listed as a first class national protected wild animal in China. Through public education in recent years in breeding and wintering sites, no killing of the species has been reported, while human disturbance on its habitats is high, which needs to be improved.

Breeding areas in China are protected by the Changbai Mountain National Nature Reserve (Jilin Province) and Bishui National Nature Reserve (Heilongjiang Province). Other protected areas within the species wintering range in China are mainly national wetland parks: Yuanshui, Wuqiangxi, Xiuheyuan, etc. No Ramsar sites or EAAF network sites are officially designated.

**ROK**

The species is included in NIBR (2012) as an Endangered species, and listed as A1c in accordance with IUCN Red List Criteria, i.e. as a species that has a reduced population of >70% over 10 years or three generations, with a decline in area of occupancy, extent of occurrence or habitat quality. However, with the exception of two species-specific nationwide surveys conducted by Birds Korea (Moores & Kim 2014) and incidental counting of the species during the annual winter bird census conducted under the auspices of the Ministry of the Environment since 1999, there has been no coordinated nationwide or detailed research on the species' distribution, ecological requirements or the conservation status of favoured rivers.

Moreover, while the Ministry of Environment has jurisdictional responsibility for the conservation of biodiversity, none of the preferred rivers used by wintering birds that were identified by Moores &

Kim (2014) are contained within protected areas; and almost all areas known to support the species have been modified to varying degrees by dredging, dam, road and bridge building during the past decade as well as in previous decades, as the rivers and all areas contained within the bunds that contain the rivers are under the administrative jurisdiction of the Ministry of Land, Transport and Construction (and derivatives thereof).

**Russia**

Scaly-sided Merganser is listed in the Russian Federation Red Data Book (2016 Edition category 2 – steadily declining with potential for being critically endangered) which affords it full protection. There are high penalties for killing the species or destroying its nests. Enforcement of this legal protection is, however, poor.

Breeding rivers in Russia are protected by the following State Nature Reserves: Sikhote-Alinskiy, Botchinskiy, Komsomol'skiy and Lazovskiy (zapovedniks = strict reserves). Other federal protected areas within the species range in Russia are the following National Parks: Anyuiskiy, Zov Tigra, Bikin and Udegeyskaya Legenda, and the Tumninskiy. Locally protected areas are the Chukenskiy, Birskiy, Bobroviy, Gurskiy, Ust-Urminskiy, Taezhniy and Vasilkovskiy zakazniks and the Khoso and Arseniev Nature Parks. One protected area is proposed (Kur zakaznik). There are ten IBAs in the Russian Far East, no Flyway Network Sites have been designated.

## 3. BIOLOGICAL ASSESSMENT

In the past decade, monitoring and research of Scaly-sided Mergansers has been undertaken in some detail at a few study sites in the core breeding range and at some wintering sites. The combination of remote breeding areas and high sensitivity of the species to habitat changes makes study difficult. The extent of the wintering range is poorly known, as are key sites within it. In most range states, there are relatively few academic or volunteer ornithologists studying or monitoring the species. Consequently, data are often incomplete or lacking and much of the information collected before the year 2000 has been published in Russian or Chinese and is therefore not generally accessible by non-native speakers. These factors greatly limit the understanding of how issues affect the species and of conservation requirements and in some cases, there is relatively little hard evidence with which to determine to what extent some of the threats are actually a problem. As a consequence, whilst there is a reasonable qualitative understanding of conservation status, population size, distribution, trends and threats, the lack of data makes it difficult to recommended specific solutions for some of the conservation problems. Poor genetic diversity was confirmed both by mt-DNA and random amplified polymorphic DNA (Solovyeva & Pearce, 2011; Zhang *et al*. 2013).

### 3.1 Taxonomy and biogeographic populations

Phylum: Chordata

Class: Aves

Order: Anseriformes

Family: Anatidae

Tribe: Anserini

Species: *Mergus squamatus* (Gould 1864)

**Common names**

English: Scaly-sided Merganser (also Chinese Merganser)

Mandarin: 中华秋沙鸭 (zhong hua qiu sha ya)

North Korean: 비오리 (Biori)

Japanese: コウライアイサ(Kõrai-aisa)

Russian: Чешуйчатый крохаль (cheshuichatyi krokhal)

South Korean:호사비오리 (Hosa biori)

Vietnamese: Vịt mỏ nhọn [phonetic]

The Scaly-sided merganser is monotypic, and there is just one biogeographic population. This Action Plan covers the entire world population.

### 3.2 Distribution throughout the annual cycle

The Scaly-sided merganser is a short-distance migrant (Figure 1). It breeds in Far Eastern Russia and northeast China, and probably also in the DPRK. Males and some females moult primarily on rivers to the north and northeast of the breeding grounds, and to a lesser extent in coastal areas or estuaries also north of breeding range (Solovyeva *et al*., 2014a; 2016). The species migrates southwest to the ROK and mainland China, where the majority of the population is thought to winter in the Yangtze River catchment. The same migration route is followed, in reverse, in spring. Scaly-sided Mergansers show high site fidelity to both breeding and wintering areas (Solovyeva *et al.* 2012).

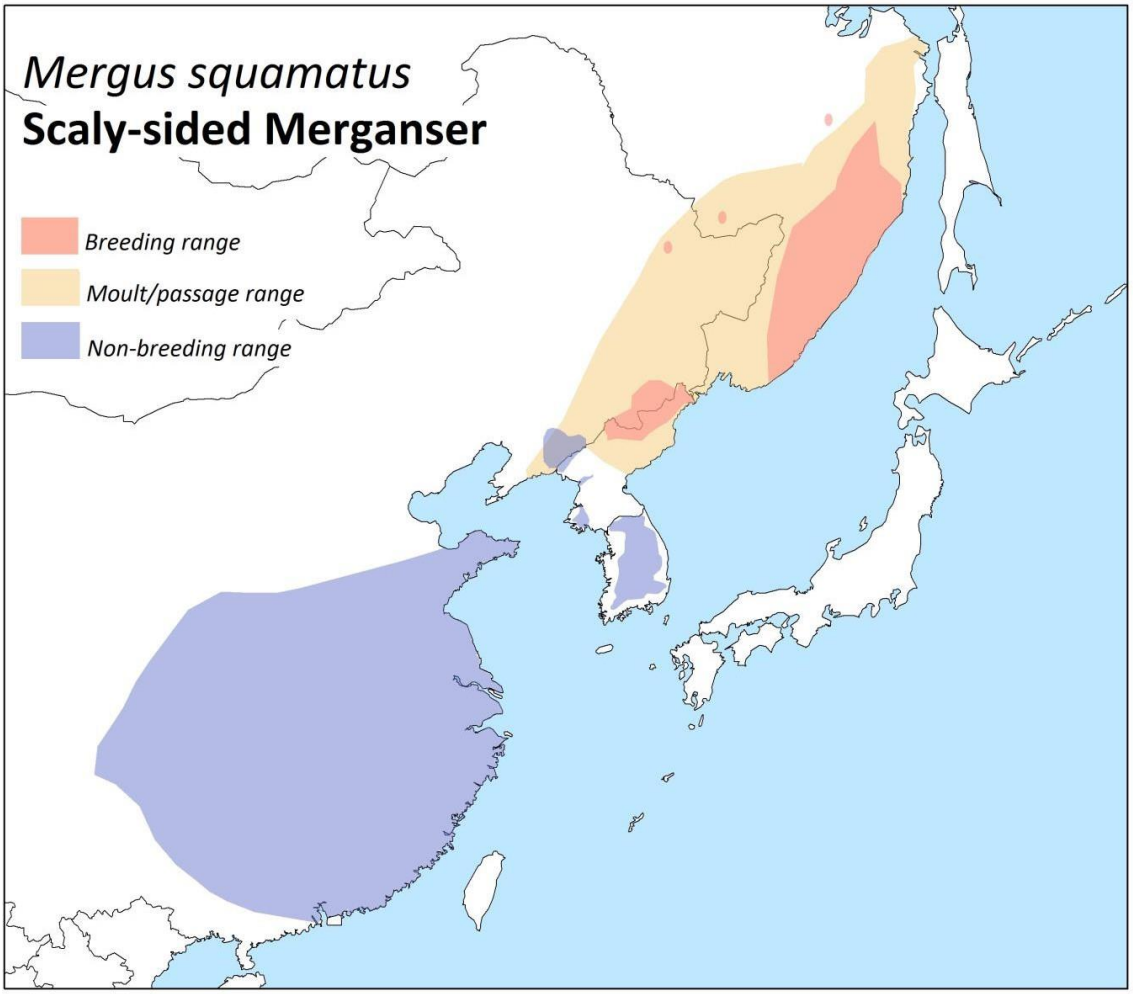


**Figure 1. Range map of Scaly-sided Merganser (compiled by David Broughton from Moores & Kim 2014, Solovyeva *et al*. 2014a,b, 2016, Zeng *et al*. 2015 a).**

The majority of the population (85%) breeds in the Sikhote-Alin mountain range in Far Eastern Russia (primarily in Primorsky Krai and Khabarovsk Krai) (Solovyeva *et al.* 2014b). Most of the remainder (14%) is found in the Changbai Mountains / Baekdu Massif, straddling China (Jilin Province) and the DPRK, though there have been no recent surveys in the latter country to confirm its continued presence there. Recent surveys have provided a reasonably precise delimitation of much of the breeding range.

There were significant changes in breeding distribution in the 20th Century. Previously occupying a large area of the Greater and Lesser Xingan Mountains in China, breeding is now reduced to around twenty pairs in a small portion of the Lesser Xingan. Numbers in the eastern Chinese part of the range (the Changbai Mountains / Paekdu Massif) were considered a small part of the total in the 1980s. The population has grown there and this area now supports the largest numbers in China. A similar picture was observed for the Sikhote-Alin Mountains in Russia – the small number of breeding pairs in the 1970s had increased significantly by 2006. Though it might be speculated that there has been a redistribution of breeding birds from west to east, there are insufficient data from historical censuses to draw any clear conclusions.

Males and non-breeding females moult in pristine rivers to the north and east of the breeding rivers, and some birds in coastal locations, as far north as Central Kamchatka, the Koryak coast and the Commander Islands (Buturlin & Dementiev 1935. Isakov & Ptushenko 1952, Gerasimov 2006).

Scaly-sided Mergansers migrate up to 3,000 km southwest to winter primarily in mainland China (Figures 2, Barter *et al*. 2012). From the breeding rivers in Russia, birds migrate south over the Sea of Japan / East Sea and the Yellow Sea to the Yangtze catchment. Most birds stage for about a week on rivers in the ROK and the DPRK but some birds migrate direct to their wintering grounds in a single flight. Some birds remain at staging sites longer - up to 67 days. Spring migration follows a similar route and is generally faster.

Migration timing and routes have been studied for birds breeding in the South Sikhote-Alin and Lesser Xingan (Solovyeva *et al*., 2012, Dong-Ping *et al*. 2014), though for the majority of breeding population these patterns are unclear.

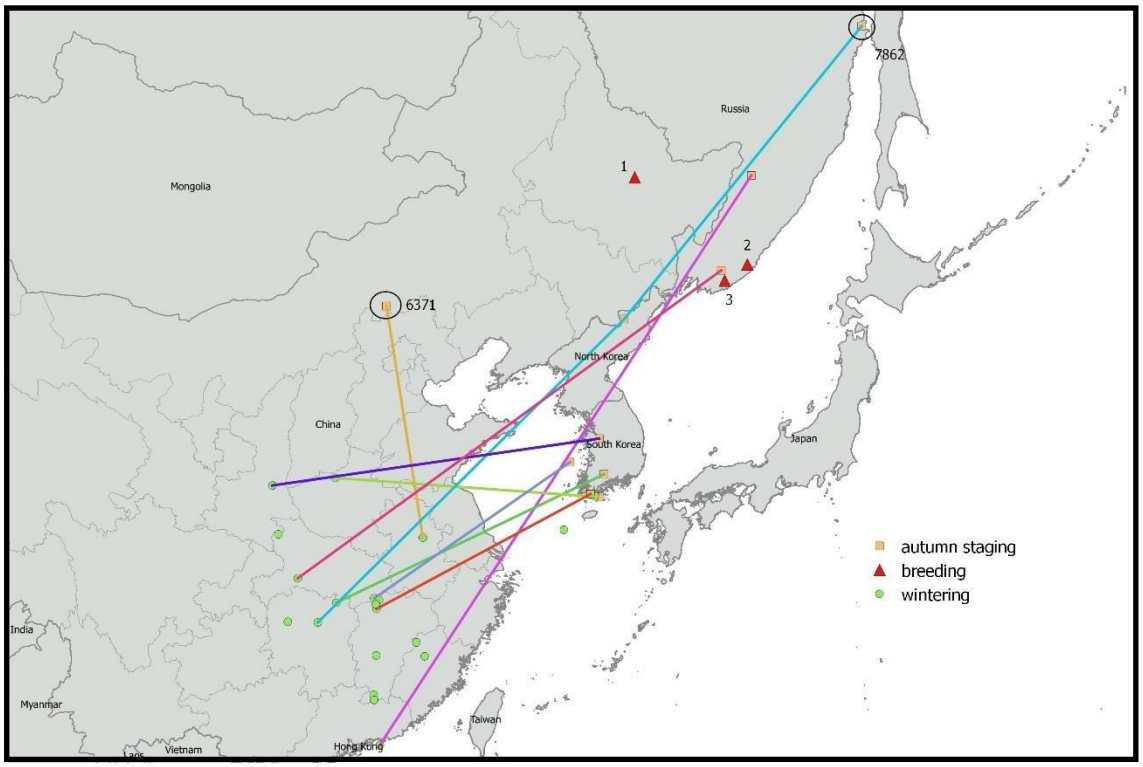


**Figure 2. Migration route, staging and wintering locations of Scaly-sided Merganser females (Solovyeva *et al*., 2012, Dong-Ping *et al*. 2014).**

The majority of the population is believed to winter in central mainland China, mostly within the Yangtze River catchment. A large proportion of birds fitted with data loggers wintered in Jiangxi Province, but the extent of the wintering range is relatively poorly known and was estimated from modelling (Zeng *et al*. 2014). Surveys have only located a small proportion (less than 20%) of the known population (Barter *et al.* 2014).

Perhaps up to 250 individuals also winter in the DPRK and the ROK (where 150-200 winter annually), with numbers able to overwinter perhaps dependent on the severity of the weather (Moores 2014).

Small numbers have also been recorded wintering in Russia and birds also occasionally occur in winter in Japan, Thailand, Myanmar and Taiwan Island.

### 3.3 Population size and trend

Based on surveys in the breeding range during 2000–2012, the population is estimated to be *c* 1,940 pairs (or *c* 4,660 birds prior to reproduction) (Solovyeva *et al.* 2014). This comprises 1,654 pairs in Russia (1,643 in the Sikhote-Alin), 166 pairs in China (155 in the Changbai Mountains), and an estimate of 116 pairs in DPRK (all in the Baekdu Massif / Changbai Mountains).

Solovyeva *et al.* (2014) reported a contraction in range in northeast China: the species was extinct in the former breeding range in the Greater Xingan Mountains and the Chinese side of the Ussuri catchment, and close to extinction in the Lesser Xingan Mountains, with just 11 pairs remaining. There was an increase in the Changbai Mountains since the 1970s, which appears to have stabilised since 2008.

A significant decline was reported in the northwest Sikhote-Alin in 1960s and '70s, followed by an increase between the 1990s and 2006, since when numbers have also stabilised.

Many previous publications showed the breeding range extending west a considerable distance inland in Russia, but detailed examination of past records suggests these were erroneous. Solovyeva *et al.* (2014) concluded that it probably never occurred over an extensive area west and north of the Amur River and historically Scaly-sided Mergansers may never have been much more numerous or extensive in Russia than at present.

### 3.4 Survival and productivity

Few data are available on adult survival or generation length. The oldest known bird from ringing recoveries is a female that reached nine years old (few males have been ringed).

Females first breed when they are two years old, males when they are three or four. Unusually for a duck, there are more females (59%) than males in the spring and summer population. Breeding trios (one male accompanied by two females) occur regularly, on average accounting for 11.1% (range 3.8-22.2%, n=703) of breeding 'pairs' during 2000 to 2015; such polygyny is atypical in the Anseriformes (Donald 2007). Theoretical models predict that in monogamous mating systems the extinction probability of small populations is likely to be lowest when the sex ratio is balanced, and in polygynous systems extinction risk is lowest when the sex ratio is female-skewed (Bessa-Gomes *et al*. 2004). Female-skewed sex ratios have been observed on several breeding rivers in the Sikhote-Alin and Changbai Mountains (Solovyeva *et al.* 2016; Liu *et al*. 2010).

Average clutch size is 11.1 ± 0.7 eggs (range 7–19, n=126). Intraspecific nest parasitism (when more than one female lays in the same cavity) is common. Nest success averages 69.9% (range 38–100%, n=166). Key nest predators are Yellow-throated Marten *Martes flavigula* and Sable *Martes zibellina*, which are known to also take nesting females, and Schrenck's Rat Snake *Elaphe schrenkii* frequently takes newly-hatched ducklings. Brood size declines rapidly after hatching and average fledging success is less than four ducklings per brood (6.2 ducklings in August). There are several avian and mammalian predators of young and adult birds on breeding rivers and in moulting areas.

The proportion of young birds in the breeding population is high, with second or third-year females accounting for average 30% (range 0–42.9%, n=55) of all nesting females and young birds accounting for a maximum of 15.5% (3.3–38.5%, n=2541) of all birds during the pre-nesting period.

### 3.5 Habitat requirements

The Scaly-sided Merganser is the most freshwater species of seaduck, almost exclusively using freshwater habitats, particularly fast-flowing rivers, for most of the annual cycle. It is not known to form aggregations (flocks number fewer than 100 individuals).

Breeding habitat requirements include mature broadleaf forest on the banks of clean fast-flowing rivers. It nests solely in tree cavities (or in artificial boxes and tubes designed to emulate natural nest sites). Both water transparency and the presence of cavity-containing forest are important in the selection of breeding habitat. Nest cavities vary in height from 2 to 26m and are mainly found in oak *Quercus*, poplar *Populus*, linden (lime) *Tilia* and willow *Salix*, with small numbers in other species. There is high competition for nest sites with owls, rodents and some insects, such as bees.

The north and west extent of the breeding range is probably determined by natural factors (it coincides with the distribution of Manchurian flora and fauna, such as Mongolian Oak *Quercus mongolica*, Amur Tiger *Panthera tigris altaica* and Yellow-throated Marten *Martes flavigula*).

Scaly-sided Mergansers feed on various fish species, frogs and water insect larvae on the breeding grounds. Ducklings rely on small fish and larvae.

Brood-rearing females moult on the breeding rivers when rearing their broods. Failed females seemingly show three different patterns of site and habitat use following the loss of eggs or offspring: (1) remaining initially on the breeding river, occasionally visiting adjacent marine areas, then moulting on nearby marine waters; (2) moving to distant marine waters; or (3) moving to other freshwater rivers north of the breeding river and remaining there to moult before departing for the wintering grounds.

Males use a range of different habitats – fresh, marine and brackish waters, usually in pristine areas to the north and north-east of the breeding grounds – for the flightless moult period. Disturbance by humans involved in fishing activities along the breeding rivers, and the potential reduction of fish abundance on the breeding areas, may explain why birds use moult sites in the Russian forest away from the breeding rivers.

In winter, almost all birds are found on rivers and freshwater reservoirs. Ideal winter habitat seems to be similar to that used for breeding: fast-flowing clean mountain rivers with a variety of fish. Modelling showed favoured habitats were rivers and reservoirs within an area with mid-winter air temperatures of above 2$^{o}$C (Zeng *et al.* 2015). Diet in winter is poorly studied but includes different fish species.

### 3.6 Captive population

The global captive population is estimated to be between 650 and 700 birds - 79 are part of EAZA/AZA breeding programmes with a further 460 – 660 individuals held by private individuals.

The European captive population was established by the private sector, not via zoo imports, and is thought to derive from only three birds, two of which siblings, from the Avvakumovka River in Far East Russia. It is possible that further imports were made via Erwin Maas, of Belgium, on two or three separate occasions. These were also imported from the East Primorye. Birds were bred in captivity

from the first time in 2002. Since then the only organisations to have bred them successfully are Pensthorpe, Blackbrook & Berlin Tierpark.

The EAZA Zoo population has been monitored since 2011 and was upgraded to a European Studbook on 12 March 2013. This is run by Johnpaul Houston of Blackpool Zoo. There were five EAZA zoos holding Scaly-sided Mergansers in 2014 (Augsburg, Berlin Tierpark, Blackpool, Prague and Wuppertal) plus three other non-EAZA zoos (Pensthorpe, WWT Arundel and Cottbus). There are a total of 40 Scaly-sided Mergansers held by organisations in Europe (18 males and 22 females). The best breeding year so far was in 2014 with 19 mergansers hatched at Pensthorpe following an import of new males. In European private aviculture the species is sustained in large numbers by numerous private breeders – estimated 400 – 600 individuals.

The North American captive population were imported from Europe: the International World Waterfowl Association imported birds to Sylvan Heights and the Wildlife Conservation Society imported birds to Central Park Zoo. Chuck Cerbini of Toledo Zoo runs the AZA Scaly-sided Merganser Species Survival Plan Program and there are now a total of 39 mergansers in AZA accredited institutions. Since 2007, private breeders have been very successful at breeding Scaly-sided Mergansers in the USA and there are estimated to be around 60 birds in total - at Livingston Ripley, Sylvan Heights, Pinola Conservancy and Dry Creek Waterfowl, all of which bred Scaly-sided Mergansers in 2015. AZA zoos are now struggling to find holders with the necessary facilities to keep Scaly-sided Mergansers and so the population growth in accredited zoos is slowing whilst new holders are sought.

## 4. THREATS

Threats are ranked according to the following relative scale:

- **Critical**: a factor causing or likely to cause a rapid and major decline and potentially extinction.
- **High**: a factor causing or likely to cause rapid and/or major decline.
- **Medium**: a factor causing or likely to cause slower but significant decline.
- **Low**: a factor causing or likely to cause fluctuations.
- **Local**: a factor causing or likely to cause declines in only some areas, with little or no overall effect at the population level.
- **Unknown**: a factor that is likely to affect the species but it is unknown to what extent.

Assigning a particular rank to threats using the above definitions can sometimes be difficult, especially when the impacts have not been fully quantified. An important aspect of the assessment is therefore the relative ranking of each threat, which provides prioritisation for subsequent action.

### 4.1 Priority threats

**Poaching Importance: high**

Although the species is protected in all Range States, and killing of birds is forbidden, shooting of adult Scaly-sided Mergansers is a key threat in the Russian breeding areas. Only low levels of shooting occur in China, and it is not thought to be a threat either in breeding or wintering areas in that country.

The timing of the hunting seasons in Russia increases the pressure upon Scaly-sided Mergansers as only this species and Mandarin Duck *Aix galericulata* may be present at those times. Most Scaly-sided Mergansers are shot in spring, when there is a legal hunting season for males of dabbling and some diving ducks. The spring hunting season is short (just two weeks) and popular among hunters, and coincides with the arrival of Scaly-sided Mergansers. The spring hunting season is normally from late March to early April, but the precise dates vary each year – later dates are likely to exacerbate the problem. Since 2010, the dates for the hunting seasons have been set by Moscow in consultation with the local regions though it is unclear what data are used to decide the dates. Dates are set usually a month beforehand and published in newspapers. Scaly-sided Mergansers are most likely to be shot when entering breeding rivers from the sea.

Hunting is also permitted in autumn but fewer Scaly-sided Mergansers are shot at that time. The autumn hunting season is from the last weekend of August until 31 December and only at nominated wetlands (some rivers, river estuaries, lakes, bogs). Shooting on most rivers is prohibited in autumn and allowed on only a few that are important for Scaly-sided Mergansers (the Pavlovka, Zhuravlevka and Ussuri Rivers). Hunting effort is less concentrated in autumn because the season is longer, and most legally hunted duck species migrate earlier than the departure of Scaly-sided Mergansers and use different habitats.

Poaching probably also occurs outside the open hunting seasons. Scaly-sided Mergansers are shot for sport rather than for subsistence. Russian law only permits the shooting of birds on the water, though it is likely that many Scaly-sided Mergansers are shot in flight. Numbers of Scaly-sided Mergansers shot are generally thought to be relatively small – usually a few birds per river, though in years when the timing of the hunting season occurs before or after the main migration of legal quarry species, hunters are more likely to shoot non-quarry species. In 2007, for example, 26 Scaly-sided Mergansers were reported shot at the mouth of the Kievka River (14% of the local population). Poaching of Scaly-sided Mergansers is most prevalent in the eastern Sikhote-Alin.

In China, guns can only be used in designated hunting zones. Because Scaly-sided Mergansers do not generally associate with other ducks during winter, the potential for their being shot is limited.

Some Scaly-sided Mergansers are shot accidentally, as some hunters do not recognise the species. Identification skills in general are thought to be relatively poor and there is considerable potential for confusion with Goosander *Mergus merganser*. There is also a generally poor understanding of the law, and some hunters do not know that the Scaly-sided Merganser is protected. Some hunters deliberately ignore the law as it is unlikely that they will be caught.

Hunters in Russia are required to have a licence but since 2013 training is not required to obtain a licence. The authorities have insufficient resources to enforce the legislation and since 2000 the number of inspectors outside refuges has decreased.

With the improving economic situation, the number of people owning guns is likely to increase, so there is potential for this problem to increase.

**Fishing nets Importance: high**

Gill nets and sleeve nets used across rivers to catch fish also accidentally catch Scaly-sided Mergansers, many of which drown. These nets can be used under licence in China, but their use on the most of the rivers is illegal in eastern Sikhote-Alin Mountains, Russia. Although nets can be used in both the ROK and the DPRK, they are not believed to pose a threat in those countries as they are used in slow-flowing rivers, and not across the upper reaches of rivers favoured by Scaly-sided Mergansers.

The threat is most prevalent in the Sikhote-Alin Mountains, Russia, where the nets are used across fast-flowing rivers. Nets are also used in the Khabarovsk/Amur Basin, but in slow channels between lake systems, which are not favoured by Scaly-sided Mergansers. Fishing is used particularly by poorer villagers to catch fish for food and to sell fish and fish eggs, providing a significant source of income, primarily from June to early August. Although fisherman will release birds found in nets, most birds die as fishermen cannot extract them in time (many nets are unattended much of the time). Its impact is greatest during the period when birds cannot fly, and it has the potential to kill whole broods.

Though illegal, the legislation is not enforced (different authorities are responsible for fishing and hunting). This reflects not so much a lack of resources but a change in mentality to allow natural resources to be exploited. It is known that police participate in fishing, especially for eggs.

Fishing nets are more numerous in recent years (every kilometre in some places) in the Sikhote-Alin, and are used more blatantly in defiance of the legislation.

Fishing nets are used legally for fish farming in China, and the numbers in use are thought to have diminished when fishing was legalised. Nets continue to be used illegally also, both by poor people but also contracted by richer people. Laws are not enforced by the authorities. This is complicated by the division of responsibilities for different aspects between different government offices.

In China, sleeve nets are considered to have greater effect on Scaly-sided Mergansers. These are used when water flow is lower (in summer) and dams remain in place to channel the water into the net. The threat in China is overall considered to have only a regional effect.

**Permanent dams Importance: high**

Dams, particularly in China and particularly in the wintering areas and also in the ROK, are considered to be a major threat. While their precise impact has not been studied, the significant changes to river flow and form are likely to have a major effect on the suitability of rivers as feeding areas for Scaly-sided Mergansers.

Dams are common and widespread in central and eastern China. Dams for hydro-electricity generation tend to be the largest, while medium-sized dams are used for water supply, both for drinking and especially for irrigation. Large dams cause a major change to the environment for ten or more kilometres upstream, and in some cases there are also downstream effects. Although individual dams may not be especially large, they are sometimes used in series, with a dam every 5–15km. Dams placed in the middle and upper stretches of larger rivers have the greatest impact upon Scaly-sided Merganser feeding areas.

Some important wintering sites for Scaly-sided Mergansers occur directly below dam walls, probably because the faster- flowing water creates suitable habitat. The lack of observations prior to construction means, however, that it is not known if these sites were already favoured by Scaly-sided Mergansers. It is possible that these locations remain the only suitable feeding sites within river systems that have been largely modified.

Dams occur on the vast majority of rivers in China and the ROK. They are usually sited in the middle and lower reaches of medium-sized rivers, areas that might otherwise be good wintering rivers for Scaly-sided Mergansers. There is no information on whether any known Scaly-sided Merganser sites have been lost directly because of dam construction, but it is considered inevitable that this must have occurred.

Dam construction is expected to continue in China (and in the ROK). The country is water-stressed and there is a national energy deficit. Dams are an attractive option because there are few alternative energy sources and they are a source of green energy. Many dams are old, poorly constructed and probably inefficient. Whilst there is a potential that these may be retired, and that wind farms and new thermal plants may replace some dams, the strategic plan for dam construction is unknown. Whilst energy provision over long distances is relatively easy, it is likely that a widespread need for medium dams will persist as part of a water-supply strategy. The increasing human population and the drive for economic development will continue the increased demand for water and electricity. In some cases, dams have been built to generate economic development.

Although there are fewer dams within the breeding areas in China, proposals for hydro-electric schemes are being promoted by Governor of Jilin. Both small and medium dams (affecting perhaps 6–7km upstream) are envisaged, including several within the Changbaishan breeding areas. Dams in these areas are, however, likely to have only a regional effect on the Scaly-sided Merganser population.

In the DPRK, there is also a drive towards dam development, with the Government encouraging construction. The scale and strategy for this is unknown. Without clearer information on the numbers and distribution of Scaly-sided Mergansers in the country, it is unclear what the effects might be.

There is at least one proposal for major dam construction in the ROK on a river used by substantial numbers of Scaly-sided Merganser. The 'Four Rivers Project' (mostly conducted between 2009 and 2012) has already resulted in several new dams (along with reservoirs and canalisation of rivers), including in rivers used by Scaly-sided Mergansers.

**Pollution Importance: at least medium, probably high**

Wintering sites in central China are considered highly contaminated with persistent organic pollutants (POPs) and heavy metals from industrial development and poor environmental practice and regulation. This has the potential to affect Scaly-sided Merganser prey abundance both directly and indirectly as well as having a direct impact on the mergansers themselves. Scaly-sided Mergansers caught in Russia (particularly those using nest-boxes) and their eggs are contaminated with medium to high levels of heavy metals (Solovyeva *et al.* in prep.). POPs have not been investigated in Scaly-sided Mergansers.

Industrial waste from manufacturing, mining and smelting in the wintering areas in China is potentially a large problem as water is likely to be discharged into rivers with minimal treatment (small-scale mining in the Scaly-sided Merganser breeding areas is not thought to be an issue). Heavy metals and organic compounds are likely to enter water courses from a variety of sources, from large factories to cottage industries. The numbers and locations of mines, factories and smaller businesses and the extent to which these affect key and likely wintering rivers for Scaly-sided Mergansers need to be determined.

Often there is only primary treatment of waste water before discharge and domestic waste can be discharged directly into a water source. There is often no controlled disposal or treatment of garbage – it is simply piled outside cities – and collection and disposal is non-existent in more remote areas. The extent and impact of non-point source pollution from agrochemicals and pesticides is unknown but likely to be widespread.

Water quality in many areas in China is scored as '5', considered unfit for any use. Water quality is known for larger rivers but may not be available for rivers used by Scaly-sided Mergansers.

Although central Government encourages and provides money – which is also provided through international funds – for treatment plants, these may not be funded locally and fall into disrepair. Individuals will keep money for profit rather than pay for treatment. There appears to be lack of appreciation of the problem centrally, and of environmental issues generally, with a focus on development and growth.

In DPRK, the approach to water treatment appears to be largely similar to that of China. An iron mine results in large discharge and environmental damage on the upper Duman River. Otherwise, the much smaller-scale of human habitation and development means there is likely to be rather less industrial pollution. However, more research is required to determine the ecological health of rivers used by the species.

In Russia, there is only one case of concern, past gold mining on Pompeevka River in the Jewish Autonomous Okrug. Previous problems from mining and industry – concerning heavy metal pollution and suspended clay on the Bikin River (Bocharnikov & Shibnev 1994) and an ore-processing plant and a gold-mining complex on the Iman River (Surmach & Zaykin 1994) – no longer appear to be a threat.

Pollution is currently not considered to be a serious issue to the species in the ROK.

### 4.2 Additional threats

**Dredging Importance: medium**

Extraction of gravel and sand from rivers is considered to be a medium threat in wintering rivers in China (as in the ROK), but of low importance in breeding areas. Dredging causes a change in river morphology, an increase in turbidity, which continues downstream of the activity, and disturbance. Scaly-sided Mergansers were found to favour areas with larger and more contiguous gravel patches, and less human disturbance during the winter in China (Zeng *et al*. 2015).

There is extensive extraction of gravel in wintering areas in China associated with the national drive to increase GDP (China is responsible for 40% of world concrete consumption) and it is widespread onall rivers. Licences for dredging are granted by local government and the activity is mostly local (ratherthan by large companies).

In breeding areas in China, there is widespread extraction of sand. Increased turbidity is generally short-lived because of water flow, but changes in riverbed morphology may have a serious effect on the river and also bank-side trees. It is unknown if the activity occurs in fish-spawning areas.

The drive for increased development and tourism in Jilin (the city of Songjianghe is projected to increase from 10-20,000 to 100,000 people with plans for highway and rail links) adjacent to Scaly-sided Merganser breeding areas drives the need for sand and aggregates. Although there dredging is regulated, this is not enforced.

Gravel extraction occurs in breeding areas Russia, but the activity is very limited, and the declining human population in the region means there is only a low potential for this to be a problem in future.

In the DPRK, local enterprises regularly extract aggregates around towns and villages for general development, presumably including in Scaly-sided Merganser breeding areas. This generally involves bank-side collection, so has a lesser effect on river morphology and turbidity. Small-scale gold extraction (both by individuals and mechanised) can create increased turbidity locally.

There is industrial-scale and local aggregate extraction in the ROK but the effects of this on Scaly-sided Merganser passage and wintering areas has not yet been studied.

**Disturbance Importance: low**

Disturbance arises from a number of activities, and is increasing in some areas as result of increasing development and growth, particularly in China and the ROK, and the associated expansion of roads and other transport infrastructure alongside rivers. A particular concern in breeding areas is the disruption of broods, especially from boats and other river users.

The primary cause of brood disruption is boats associated with tourism, which is increasing in both the Primorye and Jilin. Boat use in China requires a licence, but the authorities are not discerning about where boating is allowed. No permissions are needed in Russia, but there are restrictions on the use of motorboats during the fish-breeding period. Increasing general tourism and recreation (notusing boats) in the Russian breeding area, and as a result of increased access to remote villages in China, may also cause disturbance. In some parts of the Sikhote-Alin, boats may be the primary meansof transport and boat use has increased in the last 10 years. Tourism is not yet an issue for the speciesin the DPRK, but many rivers are vulnerable to excessive disturbance from local communities (see Duckworth & Kim 2005).

Human habitation and development is increasingly an issue. Urbanisation in parts of the Changbaishan in Jilin is already thought to have caused some Scaly-sided Merganser breeding sites to be abandoned, particularly due to roads and railways being constructed close to rivers. Development and disturbance in this part of China is predicted to increase. Increased development and disturbance are also predicted in wintering areas in China, although the effect is difficult to predict. Associated with the general rise in personal wealth, domestic tourism is increasing in wintering areas, with roads alongside many rivers. In ROK bankside construction and clearance of riverside vegetation (for road traffic safety) are likely to affect the suitability of sites, both for the Four Rivers Project and on small rivers. Such activities are likely to increase. Photographers also cause disturbance at some sites.

In Khabarovsk, there is increased infrastructure for providing electricity to China. Oil and gas pipelines pass from Sakhalin to southern Khabarovsk, across the eastern Sikhote-Alin, from Siberia through Khabarovsk, and across the Bikin to the Primorye.

Fishing in the Sikhote-Alin, Russia, and in Jilin, China, is a local but increasing problem. In Russia, the problem is mainly sport fishing by people coming from outside the region. Although it is legal and licensed, the year-round fishing season extends over the entire breeding season.

Legal hunting of other duck species causes disturbance of Scaly-sided Mergansers, but the extent to which this is an issue is unclear.

**Deliberate killing because of perceived competition Importance: local**

In China, some Scaly-sided Mergansers are deliberately killed by fishery owners, perceived as a threat to their livelihood. Birds are also killed by poisoning along river stretches used as *Rana* (frog) fisheries. Both threats are considered to have only a local effect.

**Semi-permanent small dams Importance: local**

Small semi-permanent dams are used in China in Scaly-sided Mergansers breeding areas for fisheries (in combination with sleeve nets), and may be quite common (every 3–5km). They are also used in Scaly-sided Merganser wintering areas, where their primary use is for local water supply and irrigation

(there are few fish in the wintering rivers). It is considered unlikely that the dams isolate sections of the river, preventing fish moving along the river.

Dams tend to occur on smaller rivers, less occupied by Scaly-sided Mergansers, and their effect on the species is unclear. It is possible that the water behind the dams may be used as feeding pools.

**Overfishing Importance: local**

Although illegal, fishing – particularly electric fishing – is widespread in China. It occurs through the year, often during the night. Fish numbers are already considerably depleted (fish are rarely seen in rivers) and that few waterbirds are seen on rivers in China may reflect the absence of food. The impact on Scaly-sided Mergansers is unclear though probably small (other threats have a larger impact). Fishing is thought to occur in DPRK, though the extent is unknown.

Fishing is for personal or local consumption. There is little or no enforcement of regulations by the authorities, particularly in rural areas.

**Logging Importance: local**

Commercial logging occurs in all three breeding Range States and generally seems to be well regulated, with little direct overlap with Scaly-sided Mergansers. Local extraction (for firewood or timber) also occurs, but is considered likely to be a problem only in certain areas.

Commercial logging is regulated in Russia. In Primorye and Khabarovsk, logging is prohibited in river flood plains. The tree species targeted (notably ash *Fraxinus* and oak *Quercus*) are not favoured by Scaly-sided Mergansers for nesting. The larger commercial companies are more likely to comply with legislation in order to receive certification for their activities. The rafting of logs on rivers has been totally prohibited and so is no longer an important issue for Scaly-sided Mergansers.

Previously, local communities obtained government 'tickets' to take trees for firewood, but access to the majority of woodland is now restricted because large areas are contracted to companies. A forest code requires that old large trees are felled for 'sanitary' reasons, to prevent them falling and damaging other trees good for logging. The code imposes a buffer zone of 50 m around small rivers and 500m or more around bigger rivers. Locals do, however, take trees within flood-plain forests immediately around villages, concentrating on smaller trees because they are easier to transport. This nevertheless poses a possible threat for Scaly-sided Mergansers, and a heronry was largely destroyed through this activity. Any logging is prohibited in buffer zones. There is greater potential for this to be an issue in southern Primorye because of the higher human population density. No changes in forestry management drivers are anticipated in the near future, particularly away from southern Primorye.

In China, the peak in logging was during the 1970s. Forestry rights are owned by Government and the State Forestry Authority produces an annual logging plan that allows only a small amount of virgin forests to be logged. All riverine sections (500 m either side of the river) are protected and logging is banned. International Forest Certification requires that any endangered species is protected and the European market will only buy wood from responsible sources, which drives a large increase in the price of wood.

Management rights have been passed to local (private) people to ensure more sympathetic management. Forests are classified and in 'ecological forests' people are only allowed to use the land or tree products (*e.g.* pine nuts) but are not permitted to fell trees. Other forest classifications allow

only selected logging. This has decreased the incidence of illegal logging, though it still occurs, it is expected to have a positive impact on Scaly-sided Mergansers.

Forests are regenerating both naturally and through plantation. The Changbai Natural Reserve still contains primary forest along some rivers though there is a wider problem that regeneration does not yet provide adequate nest sites for Scaly-sided Mergansers because the trees are too young.

In DPRK, logging is primarily for local timber supply (for commercial reasons), but also of underbrush for heating and fuel by villagers, and for clearance for cultivation. Commercial logging for wider markets may continue at a low level. Logging is not allowed along river valleys, but may be not enforced. This activity probably occurs in potential or suspected Scaly-sided Merganser breeding areas.

**Fires Importance: local**

In Russia, fires are used locally for maintaining grassland areas, mainly in the southern Sikhote-Alin, which results in some local losses of habitat. It is not an issue in the northern part of the range.

China has a well-established system for quickly controlling fires and there have been no significant forest fires in Jilin for thirty or more years. Fires do occur in Heilongjiang, but are not felt to be an issue in Scaly-sided Merganser breeding areas.

Fire is regularly used in DPRK for forest clearance for agriculture, including areas close to rivers, especially in spring.

**Predation Importance: local**

Nesting females are taken by Sable and Yellow-throated Marten. Eggs are taken by snakes and ducklings are predated by snakes, Taimen *Hucho taimen*, Eurasian Otter *Lutra lutra* and introduced American Mink *Mustela vison*. Adult birds might be taken by Taimen, Goshawk *Accipter gentilis* and White-tailed Eagle *Haliaeetus albicilla*.

**Competition Importance: local**

There is competition for nest sites, both natural and nest-boxes, from owls, e.g. Ural Owl *Strix uralensis*, Siberian Flying Squirrel *Pteromys volans*, Red Squirrel *Sciurus vulgaris* and Asian Giant Hornet *Vespa mandarini* and other hornets. Mandarin Duck is not considered to be a competitor however they might cause clutch abandonment from intra-specific nest parasitism. Potential competition with Goosander occurs on the rivers in the north portion of the range.

Competition for food with other fish-eating birds and mammals is unstudied but might take place in core breeding area in Primorye. Grey Heron *Ardea cinerea*, Cormorant *Phalacrocorax carbo*, Goosander and Mandarin Duck could compete for fish and frogs as well as American Mink and Otter.

**5. KNOWLEDGE GAPS**

Current knowledge is limited for some geographic and demographic parameters for Scaly-sided Merganser, and about the extent and impact of some threats. Significant knowledge gaps may hinder

the successful implementation of conservation measures. Key knowledge gaps are identified below so that they can be addressed in the implementation of this plan.

| Issue | Knowledge gap | Priority |
|---|---|---|
| Distribution | Breeding numbers and range in DPRK | High |
| Distribution | Staging and wintering areas in DPRK | Medium |
| Distribution | Wintering range and key sites in China | High |
| Distribution | Habitat use and requirements in winter | Medium |
| Habitat | Effect of dams on winter distribution and foraging | High |
| Demography | Juvenile survival from hatching to fledging, and from fledging to first breeding | High |
| Demography | Annual survival of males | Medium |
| Pollution | Pollution effect on egg hatchability | Medium |

## 6. FRAMEWORK FOR ACTION

### 6.1 Goal and objective

**Goal**

To remove the Scaly-sided Merganser from the threatened categories of the IUCN Red List.

**Objective**

The objective is to maintain the world population of Scaly-sided Merganser at its current level (*c*. 5,000 birds).

Ten results are identified to deliver the objective, to be achieved by implementation of specific actions. Most actions address the key threats, and some seek to address knowledge gaps about threats in order to develop appropriate actions. Further actions ensure that key sites for the species are protected, and ensure that the species is monitored appropriately, in particular to clarify its current status.

Actions should be implemented in all four Principal Range States unless otherwise indicated. It is expected that some actions can be undertaken relatively quickly, while others may take until the end of the period plan to be completed. Timescales are given as 2018, 2021 and 2025 to reflect actions that can be completed by the end of the first, second and final thirds of the term of the plan. It is expected that significant progress should have been made on all actions by 2025.

Footnotes capture suggestions made at the action-planning workshop that should facilitate implementation of certain actions, or identify specific issues for consideration.

The results and actions listed below should be incorporated into the relevant national action plans of each Range State in which they apply. Range States are, however, encouraged, through the EAAFP Scaly-sided Merganser Task Force, to develop and share best practice and imaginative ideas to implement actions. Range States are also encouraged to develop collaborative cross-border projects for implementation, as these are likely to be more effective than implementing actions in isolation.

### 6.2 Results

Ten results involving a total of 41 actions were identified.

**Result 1: Raise awareness of the issue of dams and reduce construction of new dams in sensitive areas**

It should immediately be noted that fundamental issues of development and dam construction, particularly in China, will not be turned around by individual conservation issues, but adding the Scaly-sided Merganser to the list of issues – and combining this with other initiatives to address environmental concerns – should be undertaken.

| Action | Priority | Timescale | Organisations |
|---|---|---|---|
| 1. Ensure relevant authorities (including high level Government) receive information on Scaly-sided Mergansers (to know which are important areas) and of the possible impact of developments, e.g. dams | High | Significant progress by 2018 | National and international NGOs, Universities, Academies of Science |
| 2. Make representation to EIAs for dam proposals and contribute to mitigation recommendations[6] | High | Occurring regularly by 2018 | Universities , Academies of Science, National and international NGOs |
| 3. Make representations to high level authorities about nature conservation mechanisms at appropriate meetings, e.g. CBD COP[7] | High | Occurring regularly by 2018 | National and international NGOs |
| 4. Undertake post-construction monitoring of any new dam to determine effect on Scaly-sided Mergansers in breeding and wintering areas | Medium | At least two studies underway by 2021 | National NGOs, Universities |

**Result 2: Reduce pollution in wintering areas**

As with dams (see Result 1), pollution and water quality, particularly in China, are major issues that require addressing at a high-level. Actions proposed for dams (notably 1 and 3) also apply to pollution and water quality and combining both issues in relevant actions may be advantageous.

| Action | Priority | Timescale | Organisations |
|---|---|---|---|
| 5. Make representations to high level authorities about nature | High | Occurring regularly by 2018 | National and international NGOs, Universities, Academies of Science |

[6] It is acknowledged that the EIA process is not open and difficult to influence and in some Range States no obvious mechanism exists to make representation to the authorities or process.

[7] This would address much bigger issues at a policy level, and need a high-level approach, *eg* EAAFP involvement, linked to other organisations, initiatives and/or combined with other affected species. Consider targeted side event at next COP. Might be linked to issue of water quality/pollution.

| | | | |
|---|---|---|---|
| conservation mechanisms at appropriate meetings, e.g. CBD COP[4] | | | |
| 6. Develop demonstration projects that address pollution/water quality at different scales (e.g. industrial, community, cottage industry), using Scaly-sided Merganser as flagship and/or seek to include Scaly-sided Merganser as beneficiary species in existing initiatives | High | Projects proposals developed by 2018 and underway by 2021 | National and international NGOs, Universities, Academies of Science |

**Result 3: Raise awareness of the issue of dredging and reduce the impact of dredging in sensitive areas**

| Action | Priority | Timescale | Organisations |
|---|---|---|---|
| 7. Identify future dredging activity in sensitive areas and raise awareness of effects and mitigation with authorities and relevant companies | High | Future activity identified by 2018; relevant bodies aware by 2021 | National NGOs, Universities, Academies of Science |
| 8. Make representation to EIAs for aggregate extraction and contribute to mitigation recommendations[8] | High | Occurring regularly by 2018 | National NGOs, Universities, Academies of Science |
| 9. Identify and advocate measures for site restoration | Medium | Significant progress by 2018 | National NGOs, Universities, Academies of Science |

**Result 4: Eliminate mortality from shooting in breeding and moulting grounds in Russia**

| Action | Priority | Timescale | Organisations |
|---|---|---|---|
| 10. Prohibit spring hunting of merganser *Mergus* species throughout Primorye and Khabarovsk or all key Scaly-sided Merganser rivers; or prohibit hunting of all wildfowl on key Scaly-sided Merganser breeding rivers | High | Submission by 2018; in place by 2021 | Local NGOs and authorities, SSM Project |
| 11. Develop and disseminate materials explaining plight of Scaly-sided Merganser and legal situation[9] | High | 2018 | Local NGOs and hunting organisations, SSM Project |
| 12. Ensure hunters are able to identify Scaly-sided Mergansers[10] | Medium | 2021 | Hunting organisations and authorities |

[8] It is acknowledged that the EIA process is not open and difficult to influence and in some Range States no obvious mechanism exists to make representation to the authorities or process.

[9] This has worked successfully on the Kievka River. Also consider agreements with hunting associations to champion Scaly-sided Merganser conservation.

[10] Consider developing identification charts and running training courses with hunting societies/associations.

| | | | |
|---|---|---|---|
| 13. Incorporate identification training into hunting licensing process | Medium | 2021 | Authorities and hunting organisations |
| 14. Increase in patrol effort[11] | Medium | 2021 | Authorities and hunting organisations |

**Result 5: Minimise drowning in fishing nets in breeding grounds**

| Action | Priority | Timescale | Organisations |
|---|---|---|---|
| 15. Raise awareness with villagers and authorities in Sikhote-Alin and Jilin about Scaly-sided Merganser, its plight and protected status and the need to comply with existing regulations[12] | High | 2021 | Local NGOs, schools and SSM Project |
| 16. Undertake Participatory Rural Appraisal for local villagers to identify alternative income sources (e.g. fish farms)[13] | Medium | Projects proposals developed by 2018 and underway by 2021 | Local NGOs |
| 17. Open sport fishing using rod and line and police illegal use of gill nets | Medium | 2021 | Authorities |

**Result 6: Minimise disturbance during brood-rearing period**

| Action | Priority | Timescale | Organisations |
|---|---|---|---|
| 18. Seek regulation of motorboat traffic on Scaly-sided Merganser rivers[14] | High | 2018 | Local NGOs and SSM Project |
| 19. Develop and disseminate guidance for boat-users when approaching broods (e.g. kill engines and pass broods as quickly as possible; keep to same main channels in braided sections) | Medium | 2018 | Academies of Science, Local NGOs |

[11] Consider increasing the licence fee to fund patrols or using 'advisors', e.g. local staff, hunting society members.

[12] Water and electricity authorities thought to be unaware of Scaly-sided Merganser issue; also need to ensure coordination with other relevant authorities, e.g. Forestry Bureau. Students may be a good target group (likely to be sympathetic and provide 'pester power').

[13] Many villagers are poor people and fish are an important source of food and/or income. Grants already exist for alternative livelihoods.

[14] Use of motorboats is already restricted on named rivers in May and June to minimise disturbance to fisheries.

**Result 7: Key knowledge gaps about the species and threats are addressed**

| Action | Priority | Timescale | Organisations |
|---|---|---|---|
| 20. Determine breeding numbers and range in DPRK | High | 2021 | Hanns Seidel Foundation, Birds Korea |
| 21. Identify staging and wintering areas in DPRK | Medium | 2021 | Hanns Seidel Foundation, Birds Korea |
| 22. Identify key areas for wintering in China, especially through new GPS tracking studies | High | 2018 | National NGOs, Universities, Academies of Science |
| 23. Determine habitat use and requirements in winter | Medium | 2018 | National NGOs, Universities, Academies of Science |
| 24. Determine juvenile survival from hatching to fledging, and from fledging to first breeding | High | 2021 | SSM Project |
| 25. Determine annual survival of males | High | 2021 | SSM Project |
| 26. Understand effect of dams on prey of Scaly-sided Mergansers | High | 2021 | National NGOs, Universities, Academies of Science |
| 27. Document extent and nature of water pollution in China in order to target activities | Medium | 2021 | National NGOs, Universities, Academies of Science |
| 28. Undertake research on sub-lethal effects of poisoning, especially heavy metals and pesticides on productivity | Medium | 2018 | SSM Project |
| 29. Understand effect of dredging on Scaly-sided Mergansers | Medium | 2018 | National NGOs, Universities, Academies of Science |
| 30. Understand threats during moulting period in Russia | High | 2021 | SSM Project, Academy of Science, Universities |

**Result 8: A network of protected areas, covering all important sites throughout the lifecycle, is designated and maintained and supported by wider policies**

| Action | Priority | Timescale | Organisations |
|---|---|---|---|
| 31. Ensure key sites are protected[15] | High | 2021 | Local authorities |
| 32. Nominate key sites as 'Flyway Network Sites'[16] | High | 2018 | National EAAFP representatives |

[15] In China, protected as Provincial Nature Reserves as a minimum, ideally as National Nature Reserves.
[16] Identify benefits for the site, e.g. through sister site arrangement.

**Result 9: Increase production of young through coordinated nest box programmes**

| Action | Priority | Timescale | Organisations |
|---|---|---|---|
| 33. Nest box programme within the existing breeding range | High | All times | SSM Project |
| 34. Develop nest box programme in the known areas of former breeding range (Greater Xingan, Wusuli basin) | Medium | 2021 | Academies of Science, Local NGOs |

**Result 10: Manage captive breeding populations in North America and Europe to maximise genetic diversity and establish a funding mechanism for zoos to support in situ conservation**

| Action | Priority | Timescale | Organisations |
|---|---|---|---|
| 35. Ascertain genetic diversity of captive breeding populations in North America and Europe and manage them to maximise genetic diversity | Medium | 2018 and ongoing | EAZA / AZA |
| 36. Establish a funding mechanism for zoos to support in situ conservation | High | 2018 | EAZA / AZA / WWT |
| 37. Create photographic guide to age, to aid identification in situ | Medium | 2018 | EAZA / AZA |
| 38. Increase captive breeding within European zoological institutions in line with European studbook programme goals | | 2018 | EAZA |
| 39. Find new holders with AZA institutions to continue growth of the population | | 2018 | AZA |
| 40. Investigate genetic inheritance paternally | | 2018 | EAZA / AZA |
| 41. Build capacity, and husbandry knowledge, for captive management of merganser within range states | | 2018 and ongoing | EAZA / AZA |

**7. REFERENCES**


Barter, M., Xuliang Zhuang, Xin Wang, Lei Cao, Jinyu Lei, D. Solovyeva & A.D. Fox. 2014. Abundance and distribution of wintering Scaly-sided Mergansers *Mergus squamatus* in China: where are the missing birds? *Bird Conservation International* 24: 406–415.

Bessa-Gomes, C., S. Legendre & J. Clobert. 2004. Allee effects, mating systems and the extinction risk in populations with two sexes. *Ecol. Lett.* 7: 802–812.

Bocharnikov, V.N. & Y.B. Shibnev. 1994. The Scaly-sided Merganser *Mergus squamatus* in the Bikin River Basin, Far-East Russia. Pp. 3-10 In The Scaly-sided Merganser *Mergus squamatus* in Russia and China. *TWRG Special Publ. No. 1* (Hughes, B. & Hunter, J., Eds.). WWT, Slimbridge.

Buturlin, S.A. & G.P. Dementiev. 1935. The Complete Reference Guide of Birds of the USSR. Volume 1. KOIZ: Moscow-Leningrad. [In Russian]

Donald, P. 2007. Adult sex ratios in wild bird populations. *Ibis* 149: 671–692.

Duckworth, J. & Kim C. 2005. Scaly-sided Mergansers Mergus squamatus on the lower Chongchon River, Central Korea. Wildfowl 55: 135-144. Published by the Wildfowl and Wetlands Trust.

DPRK. 2002. Red Data Book of DPRK (Animal). Published in Pyongyang, DPRK, 2002.

DPRK. 2007. National Biodiversity Strategy and Action Plan. Produced by the DPRK, UNEP and GEF. Published in Pyongyang, DPRK, 2007.

Gerasimov, Yu.N. 2006. Scaly-sided Merganser. In Red data book of Kamchatka Vol. 2: Animals: 133-134 (Torkanov, A.M., Ed.). Petropavlovsk-Kamchatskiy: Kamchatskiy Pechatny Dvor Publishing House. [In Russian]

Gould, J. 1864. Description of a new species of the genus *Mergus*. Pp. 184-185 In: Proc. Zool. Soc. London.

Isakov, Y.A. & E.S. Ptushenko. 1952. Order Anseriformes. Family Anatidae. In Birds of the Soviet Union. Volume 4: 247-635 (Dementiev, G.P. & Gladkov, N.A., Eds.). Moscow: Sovetskaya Nauka Publishers. [In Russian]

Liu, P., Li, F., Song, H., Wang, Q., Song, Y., Liu, Y. &, Zh Piao. 2010. A survey of the distribution of the Scaly-sided Merganser (*Mergus squamatus*) in Changbai Mountain range (China side). *Chinese Birds* 1(2): 148-155.

Moores, N. & A. Kim. 2014. Birds Korea Scaly-sided Merganser *Mergus squamatus* Survey,

January 2014. Birds Korea Report prepared for the EAAFP, June 2014.

NIBR. 2012. Korean Red List of Threatened Species: Mammals, Birds, Reptiles, Amphibians, Fishes and Vascular Plants. Published by the National Institute of Biological Research, Ministry of Environment. ISBN: 9788997462452.

Solovyeva, D.V. & J.M. Pearce. 2011. Comparative mitochondrial genetics of North American and Eurasian mergansers with an emphasis on the endangered scaly-sided merganser (*Mergus squamatus*). *Conservation Genet*ics 12: 839–844.

Solovyeva D.V., V. Afanasiev, J.W. Fox, V. Shokhrin & A.D. Fox. 2012. Use of geolocators reveals previously unknown Chinese and Korean scaly-sided merganser wintering sites. *Endangered Species Research* 17: 217–225.

Solovyeva, D., K.A. Hobson, N. Kharitonova, J. Newton, J.W. Fox, V. Afanasyev & A.D. Fox. 2016. Combining stable hydrogen (d2H) isotopes and geolocation to assign Scaly-sided Mergansers to moult river catchments. *Journal of Ornithology* 157 (3): 663–669.

Solovyeva, D.V., P. Liu, A.I. Antonov, A.A. Averin, V.V. Pronkevich, V.P. Shokhrin, S.L. Vartanyan & P.A. Cranswick. 2014a. The population size and breeding range of the Scaly-sided Merganser *Mergus squamatus*. *Bird Conservation International* 29: 393–405.

Solovyeva, D., J. Newton, K. Hobson, J.W. Fox, V. Afanasyev & A.D. Fox. 2014b. Marine moult migration of the freshwater Scaly-sided Merganser *Mergus squamatus* revealed by stable isotopes and geolocators. *Ibis* 156: 466–471.

Surmach, S.G. & D.V. Zaykin. 1994. The Scaly-sided Merganser *Mergus squamatus* (Gould) in the Iman Basin, Far-East Russia. Pp. 11-17 In The Scaly-sided Merganser *Mergus squamatus* in Russia and China. TWRG Special Publ. No. 1 (Hughes, B. and Hunter, J., Eds.). WWT, Slimbridge.

Wetlands International. 2016. "Waterbird Population Estimates". Retrieved from wpe.wetlands.org on Tuesday 29 Nov 2016.

Zeng, Q., L. Shi, L. Wen, J. Chen, H. Duo & G. Lei. 2015a. Gravel bars can be critical for biodiversity conservation: a case study on Scaly-sided Merganser in South China. *PLoS One* 10(5): e0127387.

Zeng, Q., Zhang, Y., Sun, G., Duo, H., Wen, L., & G. Lei. 2015b. Using species distribution model to estimate the wintering population size of the Endangered Scaly-Sided Merganser in China. *PLoS ONE* 10(2): e0117307. doi:10.1371/journal.pone.0117307.

Zhang, Z-Q., C-J. Qin, D-A Fang, A-P. Wang, C-H. Luo & K. Liu. 2013. Genetic diversity of the endangered scaly-sided merganser (*Mergus squamatus*) in the wintering habitat of central-southern China. *Genetics and Molecular Research* 12: 3103-3109.

## 8. ANNEXES

**Annex 1**. The importance of threats at the country level.

| | Overall | Breeding | | | Wintering | | |
|---|---|---|---|---|---|---|---|
| | | CH | DPRK | RU | CH | DPRK | ROK |
| **Priority threats** | | | | | | | |
| Poaching | High | low | | high | | | |
| Fishing nets | High | medium | | high | medium | | |
| Permanent dams | High | | | | high | | high |
| Pollution | Unknown, probably high | low | | | high | | |
| **Additional threats** | | | | | | | |
| Dredging | Medium | | | | medium | | medium |
| Disturbance | Low | low | low | local | local | low | |
| Deliberate killing because of perceived competition | Local | local | | | local | | |
| Semi-permanent small dams | Local | low | medium | | local | medium | |
| Overfishing | Local | Local | | medium | medium | | |
| Logging | Local | low | | local | low | local | |
| Fires | Local | Local | local | local | low | | |
| Predation | Local | Local | Ukn. | local | low | | |
| Competition | Local | Local | | local | low | | |

CH: China, DPRK: Democratic People's Republic of Korea, ROK: Republic of Korea, RU: Russia.

- **Critical**: a factor causing or likely to cause a rapid and major decline and potentially extinction.
- **High**: a factor causing or likely to cause rapid and/or major decline.
- **Medium**: a factor causing or likely to cause slower but significant decline.
- **Low**: a factor causing or likely to cause fluctuations.

- **Local**: a factor causing or likely to cause declines in only some areas, with little or no overall effect atthe population level.
- **Unknown**: a factor that is likely to affect the species but it is unknown to what extent.

**Annex 2**. Key sites for Scaly-sided Mergansers.

This list of key sites is based on the current IBA list for Scaly-sided Merganser, supplemented with information from other sites not currently recognised as IBAs for the species. The 1% threshold for Scaly-sided Merganser, a means of identifying sites of international importance, is 50 birds (WetlandsInternational 2016).

| Country / site name | EAAFP FNS[17] | IBA | Ramsar | National Designations | Season |
|---|---|---|---|---|---|
| **China** | | | | | |
| Changbai Shan Nature Reserve | N | Y | N | Y | Breeding |
| Liangshui Nature Reserve | N | Y | N | Y | Breeding |
| Shuifeng Reservoir and middle reaches of Yalu Jiang | N | Y | Y | | Breeding |
| Xinjiang Yiyang Qinghu Section | N | Y | N | N | Unknown |
| **Democratic Peoples Republic of Korea** | | | | | |
| Paekdu Mnt. | N | Y | Y | Y | Breeding |
| Myohyang Mnt | N | N | N | Y | Winter |
| **Republic of Korea** | | | | | |
| "North River" | N | Y | N | N | Winter |
| **Russian Federation** | | | | | |
| Kievka and Chernaya river basins | N | Y | Y | Y | Breeding |
| Middle reaches of the Bikin River | N | Y | N | Y | Breeding |
| Middle reaches of the Iman River | N | Y | N | N | Breeding |