FINAL REPORT TO
THE RUFFORD SMALL GRANT FOUNDATION

SCALY-SIDED MERGANSER
IN CHANGBAI MOUNTAINS, CHINA

-Breeding Pair Survey in 2009
-Nest Site Selection Study
-Brood Survey in 2009
-Threats

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**PART ONE - INTRODUCTION**

The Scaly-sided Merganser is recognized as a globally threatened species. The Changbai Mountain range (China side) is a key breeding ground of this bird. As lacking of studies and investigation, the current status of the Scaly-sided Merganser in this area is not much clear. For the conservation of this species, we need to carry out systemic surveys and monitoring programs on the breeding population in Changbai Mountains. In 2008, supported by the Rufford Small Grants Foundation, we have made surveys on the population of Scaly-sided Merganser in this range in spring and summer. In 2009, we have successfully secured the fund from RSG a second time. On the base of the surveys in 2008, our this project, *Studies on Scaly-sided Merganser breeding population and habitat selection in the Changbai Mountains*, is going on to investigate the population, distribution and threats of the Scaly-sided Merganser in this range, as well as study on some aspects of their habitat selection.

In the first ten days of April, 2009, we have made some test surveys in some Scaly-sided Merganser habitats. As the abnormal climate and late coming spring season, as well as the advice from Dr. Diana Solovyova, we timely adjusted our implement plan and made repeat surveys of these stretches later. From Apr. 14 to May 6, 13 different river stretches in total 639 km were surveyed on the breeding pairs of the Scaly-sided Mergansers. After this survey, we spent a month to seek the natural cavities. In this period of time, the continuously raining took us many difficulties to our work. But we still found seven natural cavities which are used as nests by Scaly-sided Mergansers, by climbing more than 50 trees and checking the cavities. During the second half of August 2009, even a little bit late, we still made the summer survey on the Scaly-sided Merganser brood densities in different stretches. In summer, we surveyed 290km in 9 rivers and counted 49 broods, 392 individuals of Scaly-sided Mergansers.

We would like to take this opportunity to thank Dr. Baz Hughes for his long term supervising on our program and Dr. Diana Solovyova for her guidance in methodology.

**PART TWO - SPRING SURVEY**

**Survey Area**

The area of this survey covers 41°~43°N, 125°~129°E. Aiming at figure out the southwestern boundary of breeding distribution area of the Scaly-sided Merganser in Changbai Mountain range, we newly made five survey stretches, four in the Yalu and one in Tumen river systems.

The Yalu river is a boundary river between North Korea and China. As the special geographic condition, it always firstly breaks the ice-cover in early spring. Some of its stretches in lower reach even are unfrozen in winter. Every year, some Scaly-sided Mergansers stop firstly in these stretches in early spring. In 2008, we have surveyed the Linjiang stretch in the middle reach of this river. Even we found some flocks of Scaly-sided Mergansers at the end of March, but we have not found any breeding pairs and broods in the following surveys in this stretch. So we suppose that this stretch is an important stopover site of Scaly-sided Merganser. But we once got information that some
ducklings of the Scaly-sided Merganser once were seen in Yalu river. So we set two survey stretches in both the upper and lower reaches of this river in this spring.

Map 1__The Study Area and River Stretches Surveyed in Spring, 2009

Table 1__River Stretches and Survey Date in Spring, 2009

<table>
<thead>
<tr>
<th>Survey date</th>
<th>River name</th>
<th>Survey distance, km</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apr.14–16</td>
<td>Manjiang</td>
<td>51</td>
</tr>
<tr>
<td>Apr. 19–20</td>
<td>Yalu River, Changbai Stretch</td>
<td>270</td>
</tr>
<tr>
<td>Apr. 21</td>
<td>Hunjiang Upper Reach</td>
<td>34</td>
</tr>
<tr>
<td>Apr. 22</td>
<td>Hunjiang Lower reach</td>
<td>29</td>
</tr>
<tr>
<td>Apr. 23</td>
<td>Yalu River, Jian Stretch</td>
<td>40</td>
</tr>
<tr>
<td>Apr. 25</td>
<td>Toudao Songhuajiang</td>
<td>19</td>
</tr>
<tr>
<td>Apr.26</td>
<td>Erdao Songhuajiang</td>
<td>29</td>
</tr>
<tr>
<td>Apr. 27</td>
<td>Fuer River</td>
<td>36</td>
</tr>
<tr>
<td>Apr. 28</td>
<td>Songjiang</td>
<td>26</td>
</tr>
<tr>
<td>Apr.29</td>
<td>Erdaobailehe</td>
<td>12</td>
</tr>
<tr>
<td>Apr. 30</td>
<td>Hongqihe</td>
<td>32</td>
</tr>
<tr>
<td>May 03</td>
<td>Xilinhe</td>
<td>27</td>
</tr>
<tr>
<td>May-05–06</td>
<td>Songjianghe</td>
<td>34</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>13 stretches</strong></td>
<td><strong>639</strong></td>
</tr>
</tbody>
</table>

The Hunjiang river is an small source river of the Yalu river in lower reach. We got information that some Scaly-sided Mergansers once were seen in previous years, so we also set two survey stretches in this river.

The Hongqihe river is a source in the upper reach of the Tumen river. This is the first time we survey the Tumen river system and we do find that there are but fewer Scaly-sided Mergansers distribute in this river system.
Method
All the river stretches were surveyed with rubber boat except two in the boundary river of Yalu because of bad security situation there. Fortunately, there is a road very close along the river. So we can drive slowly when we can observed the river surface with binocular and walk on the bank when it is far away from the river. In the surveys, we counted all the birds of Scaly-sided Mergansers only passed by the surveyors. In judging and correcting the breeding pairs, of Scaly-sided Mergansers, we use the same method used in 2008 under the guidance of Dr. Diana Solovyova.

Densities
In this survey, total 251 individuals, 87 corrected breeding pairs of Scaly-sided Merganser were counted. The densities of Scaly-sided Merganser breeding pair and individual over all the stretches we surveyed are $0.21 \pm 0.25$ pairs/km and $0.64 \pm 0.89$ birds/km respectively. Please see Table 2 and Table 3.

Table 2—Numbers of the Scaly-sided Mergansers Counted in the Spring Survey, 2009

<table>
<thead>
<tr>
<th>River</th>
<th>Pairs</th>
<th>Trios</th>
<th>Single males</th>
<th>Single females</th>
<th>Birds in flocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manjiang</td>
<td>11</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Yalu_Changbai</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Hunjiang_Upper</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Hunjiang_Lower</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Yalu_Jian</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Toudao_S_jiang</td>
<td>6</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>31</td>
</tr>
<tr>
<td>Erdao_S_jiang</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Fuer River</td>
<td>17</td>
<td>3</td>
<td>8</td>
<td>4</td>
<td>29</td>
</tr>
<tr>
<td>Songjiang</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Erdaobaire</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Hongqihe</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Xilinhe</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Songjianghe</td>
<td>11</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>57</strong></td>
<td><strong>11</strong></td>
<td><strong>17</strong></td>
<td><strong>10</strong></td>
<td><strong>77</strong></td>
</tr>
</tbody>
</table>
### Table 3: Scaly-sided Merganser Density (bird/km) and Breeding Density (pairs/km) in Spring, 2009

<table>
<thead>
<tr>
<th>River</th>
<th>Individuals</th>
<th>Estimated Pairs</th>
<th>Pair Density</th>
<th>Bird Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manjiang</td>
<td>47</td>
<td>18</td>
<td>0.353</td>
<td>0.922</td>
</tr>
<tr>
<td>Yalu Changbai</td>
<td>7</td>
<td>2</td>
<td>0.007</td>
<td>0.026</td>
</tr>
<tr>
<td>Hunjiang Upper</td>
<td>0</td>
<td>0</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Hunjiang Lower</td>
<td>2</td>
<td>0</td>
<td>0.000</td>
<td>0.069</td>
</tr>
<tr>
<td>Yalu Jian</td>
<td>2</td>
<td>1</td>
<td>0.025</td>
<td>0.050</td>
</tr>
<tr>
<td>Toudao_S_jiang</td>
<td>51</td>
<td>10</td>
<td>0.526</td>
<td>2.684</td>
</tr>
<tr>
<td>Erdao_S_jiang</td>
<td>10</td>
<td>5</td>
<td>0.172</td>
<td>0.345</td>
</tr>
<tr>
<td>Fuer River</td>
<td>84</td>
<td>29</td>
<td>0.806</td>
<td>2.333</td>
</tr>
<tr>
<td>Songjiang</td>
<td>1</td>
<td>0</td>
<td>0.000</td>
<td>0.038</td>
</tr>
<tr>
<td>Erdaobaihe</td>
<td>6</td>
<td>3</td>
<td>0.250</td>
<td>0.500</td>
</tr>
<tr>
<td>Hongqihe</td>
<td>3</td>
<td>2</td>
<td>0.063</td>
<td>0.094</td>
</tr>
<tr>
<td>Xilinhe</td>
<td>12</td>
<td>4</td>
<td>0.111</td>
<td>0.444</td>
</tr>
<tr>
<td>Songjianghe</td>
<td>26</td>
<td>13</td>
<td>0.382</td>
<td>0.765</td>
</tr>
<tr>
<td><strong>Total/Mean</strong></td>
<td><strong>251</strong></td>
<td><strong>87</strong></td>
<td><strong>0.21</strong></td>
<td><strong>0.64</strong></td>
</tr>
</tbody>
</table>

**Breeding Density (pairs/km) in Spring, 2009**

### Table 4: Comparison of Scaly-sided Merganser Densities in Spring of 2008 and 2009

<table>
<thead>
<tr>
<th>River</th>
<th>Individuals</th>
<th>Survey Distance</th>
<th>Pair Density</th>
<th>Bird Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manjiang</td>
<td>25</td>
<td>47</td>
<td>34</td>
<td>51</td>
</tr>
<tr>
<td>Yalu Changbai</td>
<td>3</td>
<td>7</td>
<td>32</td>
<td>270</td>
</tr>
<tr>
<td>Hunjiang Upper</td>
<td>---</td>
<td>0</td>
<td>---</td>
<td>34</td>
</tr>
<tr>
<td>Hunjiang Lower</td>
<td>---</td>
<td>2</td>
<td>---</td>
<td>29</td>
</tr>
<tr>
<td>Yalu Jian</td>
<td>---</td>
<td>2</td>
<td>---</td>
<td>40</td>
</tr>
<tr>
<td>Toudao_S_jiang</td>
<td>87</td>
<td>51</td>
<td>38</td>
<td>19</td>
</tr>
<tr>
<td>Erdao_S_jiang</td>
<td>8</td>
<td>10</td>
<td>29</td>
<td>29</td>
</tr>
<tr>
<td>Fuer River</td>
<td>75</td>
<td>84</td>
<td>33</td>
<td>36</td>
</tr>
<tr>
<td>Songjiang</td>
<td>33</td>
<td>1</td>
<td>26</td>
<td>26</td>
</tr>
<tr>
<td>Erdaobaihe</td>
<td>---</td>
<td>6</td>
<td>---</td>
<td>12</td>
</tr>
<tr>
<td>Hongqihe</td>
<td>---</td>
<td>3</td>
<td>---</td>
<td>32</td>
</tr>
<tr>
<td>Xilinhe</td>
<td>---</td>
<td>12</td>
<td>---</td>
<td>27</td>
</tr>
<tr>
<td>Songjianghe</td>
<td>31</td>
<td>26</td>
<td>29.5</td>
<td>34</td>
</tr>
<tr>
<td>Mudanjiang</td>
<td>4</td>
<td>---</td>
<td>21</td>
<td>---</td>
</tr>
<tr>
<td>Zhuerduohe</td>
<td>0</td>
<td>---</td>
<td>26</td>
<td>---</td>
</tr>
<tr>
<td><strong>Total/Mean</strong></td>
<td><strong>266</strong></td>
<td><strong>251</strong></td>
<td><strong>268.5</strong></td>
<td><strong>639</strong></td>
</tr>
</tbody>
</table>
The comparison of Scaly-sided Merganser densities between 2008 and 2009 are given in Table 4 and Chart 1. There is not obvious difference between the total numbers of Scaly-sided Merganser counted in spring of 2008 and 2009, but densities. This is because we increased the survey distance in Yalu River and newly surveyed two stretches in Hunjiang. These river stretches attribute very little to the densities. If we neglect the four stretches of the Hunjiang and Yalu rivers, the means of pair density and bird density in spring of 2009 are 0.30 and 0.90 respectively- almost the same as that of 2008 in bird density and a little bit lower in pair density than that of 2008. From Table 4, we can find that the Fuer river and the Toudao Songhuajiang still are the rivers with the highest densities. In both this two rivers, the bird densities kept steady but the breeding pair densities decreased. We found more flocked individuals of Scaly-sided Merganser in both of this two rivers in this spring. The biggest differences occurred in Songjiang. We surveyed this stretch and recorded 33 birds on Apr. 18 in 2008, but only 1 on Apr. 28 in 2009. We supposed that they did not come to this site or possibly have already left this site when we surveyed this stretch in 2009.

![Chart 1_Scaly-sided Merganser Pair Densities in 7 Rivers Surveyed in 2008 & 2009](image)

**Chart 1_Scaly-sided Merganser Pair Densities in 7 Rivers Surveyed in 2008 & 2009**

**Sex-Age Structure**

In this survey, we totally counted 77 individuals of Scaly-sided Merganser in 11 flocks. When making breeding pair estimation, we count all the flocked birds as sub-adults or non-breeding individuals. The data of the flock composition were given in Table 5. The proportion of flocked birds was 30.68%, much higher than that in year of 2008 - 18.8%.
### Table 5: Scaly-sided Merganser Flocks Counted in Breeding Survey

<table>
<thead>
<tr>
<th>River</th>
<th>Flock Components</th>
<th>Flocked Birds Unknown Sex-Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manjiang</td>
<td>2 s-ad males+4 females</td>
<td></td>
</tr>
<tr>
<td>Manjiang</td>
<td>1 male +3 females</td>
<td></td>
</tr>
<tr>
<td>Toudao_S_jiang</td>
<td>5 s-ad males+3 females</td>
<td></td>
</tr>
<tr>
<td>Toudao_S_jiang</td>
<td>3 s-ad males+3 females</td>
<td></td>
</tr>
<tr>
<td>Toudao_S_jiang</td>
<td>3 males+5 females</td>
<td></td>
</tr>
<tr>
<td>Toudao_S_jiang</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Erdao_S_jiang</td>
<td>1 s-ad males+3 females</td>
<td></td>
</tr>
<tr>
<td>Fuerhe</td>
<td>5 s-ad males+5 females</td>
<td></td>
</tr>
<tr>
<td>Fuerhe</td>
<td>1 ad+3 s-ad males+5 females</td>
<td></td>
</tr>
<tr>
<td>Fuerhe</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Xilinhe</td>
<td>3 females</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>58 (24 males+34 females)</strong></td>
<td><strong>19</strong></td>
</tr>
</tbody>
</table>

In this survey, neither pairs nor trios composed by sub-adult males were encountered. We counted 19 sub-adult males and 90 adult males. The sub adult males were 17.43% to all males and 7.57% to the total numbers of the Scaly-sided Mergansers we counted. We counted 11 trios. The trio proportion is 12.64%, a little bit lower than that in year of 2008 - 14.71%. In all the 251 birds, we counted 109 males and 123 females. The sex ratio is 1:1.30, almost the same as that in year of 2008 - 1:1.20.

**PART THREE - NEST STUDY**

**Wild Nests**

After the spring survey, we spent a month seeking the wild nests of the Scaly-sided Merganser at several forestry farms of Songjianghe Forestry Bureau from May 10 to June 15. We bought a system of professional climbing tools and they were absolutely fresh to us. We have to spent a week to practice and master this system and make out how to efficiently hang on the rope across the right limbs on top of trees. Finally, we made it. Then we went through woods looking for big broad-leaved trees with natural cavities. After climbing 53 trees, we newly found 13 natural cavities used as nests by wild ducks, except the Scaly-sided Merganser nest we have monitored since 2006. Besides the Scaly-sided Merganser, Mandarin Ducks may also make their nests in the tree cavities of the same kind in these area. We have to make judgement to all the cavities we checked to determine what ducks setup nests in them, by directly observation, trace analysis and information feedback. Among these 13 cavities, there are 4 cavities are being occupied by Scaly-sided Mergansers and another 4 by Mandarin Ducks. Two cavities are judged as old nests of Scaly-sided Mergansers by analysing the feather traces inside or near the cavities (the white downy of Scaly-sided Merganser on the bark near the opening of one cavity), as well as the confirmation by the local people. We can only make sure 3 cavities once were used by wild ducks, because we found some unhatched eggs and shells in
them. But we could not tell whether they were Scaly-sided Mergansers or Mandarin Ducks without special tests. The status of the tree cavities used as duck nests found in 2009 is given in Table 6. The cavity S_3 was occupied by a Scaly-sided Merganser in this year. We checked this nest on May 21. As the depth of this cavity is as deep as 89 cm, and we could not touch the eggs, so we used a piece of mirror to reflect the situation of this nest. There were at least 12 eggs in the nest. After three days, when we past by the river stretch near cavity 5 in the morning, we found a female Scaly-sided Merganser sitting lonely on the bank. We re-checked this cavity, there were only two broken eggs (very small embryos) and some shells left. The nest was full of very strong effluvium. We suspected that it was destroyed by other animal.

**Nest Site Selection**

We have measured some parameters of attributes describing the Scaly-sided Merganser nest cavities we have found. Up to now, we totally found 7 Scaly-sided Merganser nest cavities. With our existing climbing tools, we could not touch those nest cavities at the top on limbs, so we did not measure the data about the inside of 2 cavities (S_1 & S_5) at the far ends on limbs. Because we have monitored cavity S_1 with CCTV camera since 2007, so we made estimation to this cavity.

### Table 6: Wild Nests of Wild Ducks Found in 2009

<table>
<thead>
<tr>
<th>Cavity No.</th>
<th>Location</th>
<th>Occupier</th>
<th>Occupation Status in 2009</th>
<th>Judging Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>S_1 *</td>
<td>41°58’12.50&quot;N 127°30’46.64&quot;E</td>
<td>SSM***</td>
<td>Not Occupied</td>
<td>Direct observe</td>
</tr>
<tr>
<td>S_2</td>
<td>42°14’18.30&quot;N 127°33’1.80&quot;E</td>
<td>SSM</td>
<td>Occupied</td>
<td>Direct observe</td>
</tr>
<tr>
<td>S_3 **</td>
<td>42°11’27.50&quot;N 127°29’34.30&quot;E</td>
<td>SSM</td>
<td>Occupied</td>
<td>Direct observe</td>
</tr>
<tr>
<td>S_4</td>
<td>42°11’40.00&quot;N 127°29’49.20&quot;E</td>
<td>SSM</td>
<td>No Occupied</td>
<td>Feather trace</td>
</tr>
<tr>
<td>S_5</td>
<td>42°13’18.40&quot;N 127°26’34.50&quot;E</td>
<td>SSM</td>
<td>No Occupied</td>
<td>Confirmed by L.P</td>
</tr>
<tr>
<td>S_6</td>
<td>42°11’52.50&quot;N 127°28’36.80&quot;E</td>
<td>SSM</td>
<td>Occupied</td>
<td>Direct observe</td>
</tr>
<tr>
<td>S_7</td>
<td>42°11’34.13&quot;N 127°29’29.11&quot;E</td>
<td>SSM</td>
<td>Occupied</td>
<td>Direct observe</td>
</tr>
<tr>
<td>M_1</td>
<td>42°11’44.20&quot;N 127°29’54.90&quot;E</td>
<td>MD</td>
<td>Occupied</td>
<td>Direct observe</td>
</tr>
<tr>
<td>M_2</td>
<td>42°11’38.30&quot;N 127°30’0.40&quot;E</td>
<td>MD</td>
<td>Occupied</td>
<td>Direct observe</td>
</tr>
<tr>
<td>M_3</td>
<td>42°11’38.29&quot;N 127°30’11.82&quot;E</td>
<td>MD</td>
<td>Occupied</td>
<td>Direct observe</td>
</tr>
<tr>
<td>M_4</td>
<td>42°11’30.82&quot;N 127°29’47.42&quot;E</td>
<td>MD</td>
<td>Occupied</td>
<td>Direct observe</td>
</tr>
<tr>
<td>U_1</td>
<td>41°58’59.40&quot;N 127°31’13.40&quot;E</td>
<td>unknown</td>
<td>Not Occupied</td>
<td></td>
</tr>
<tr>
<td>U_2</td>
<td>41°51’40.81&quot;N 127°42’47.02&quot;E</td>
<td>unknown</td>
<td>Not Occupied</td>
<td></td>
</tr>
<tr>
<td>U_3</td>
<td>41°58’0.93&quot;N 127°33’40.55&quot;E</td>
<td>unknown</td>
<td>Not Occupied</td>
<td></td>
</tr>
</tbody>
</table>

* This cavity has been monitored since 2006. It had been occupied by Scaly-sided Merganser as nest every year before 2009, but not in 2009. We suspect the environmental change is the main reason affecting. The river stretch nearest was cut-off for a newly constructed hydropower station.

** Abandoned. Eggs possibly were eaten by animal. Only two broken eggs and some shells left in the nest and the hen was found not sitting in the nest but on the river bank lonely nearby in the morning.

*** SSM---Scaly-sided Merganser. MD---Mandarin Duck
In cavity S_7, as the protrudent cavity wall, we could not measure the data at the bottom. For the sake of statistic analysis, we replace these missed data with means of the variables. The collected data of the Scaly-sided Merganser nest cavities are given in Table 7.

Table 7_Attributes of Scaly-sided Merganser Nest Cavities

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Cavity</th>
<th>S_1</th>
<th>S_2</th>
<th>S_3</th>
<th>S_4</th>
<th>S_5</th>
<th>S_6</th>
<th>S_7</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOT ①*</td>
<td>poplar</td>
<td></td>
<td>elm</td>
<td></td>
<td>poplar</td>
<td>elm</td>
<td>elm</td>
<td></td>
</tr>
<tr>
<td>DBH(cm)</td>
<td></td>
<td>108</td>
<td>89</td>
<td>70</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HAB ②</td>
<td>farm</td>
<td>farm</td>
<td>forest</td>
<td>forest</td>
<td>farm</td>
<td>forest</td>
<td>forest</td>
<td></td>
</tr>
<tr>
<td>ALT(m)</td>
<td></td>
<td>843</td>
<td>746</td>
<td>714</td>
<td>714</td>
<td>727</td>
<td>710</td>
<td>720</td>
</tr>
<tr>
<td>DTR(m)</td>
<td></td>
<td>1170</td>
<td>100</td>
<td>120</td>
<td>160</td>
<td>80</td>
<td>90</td>
<td>20</td>
</tr>
<tr>
<td>HOC(m)</td>
<td></td>
<td>18</td>
<td>19</td>
<td>11</td>
<td>12</td>
<td>14</td>
<td>14</td>
<td>16</td>
</tr>
<tr>
<td>OCD ③</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>yes</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>GRD (°)</td>
<td></td>
<td>&lt;45</td>
<td>&lt;45</td>
<td>&gt;45</td>
<td>&lt;45</td>
<td>&lt;45</td>
<td>&gt;45</td>
<td>&gt;45</td>
</tr>
<tr>
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<td>mid</td>
<td>mid</td>
<td>mid</td>
<td>mid</td>
<td>top</td>
<td>top</td>
<td>mid</td>
</tr>
<tr>
<td>ASP ⑥</td>
<td></td>
<td>N</td>
<td>NE</td>
<td>NW</td>
<td>W</td>
<td>NE</td>
<td>E</td>
<td>SE</td>
</tr>
<tr>
<td>POC ⑦</td>
<td></td>
<td>limb</td>
<td>limb</td>
<td>trunk</td>
<td>trunk</td>
<td>trunk</td>
<td>trunk</td>
<td></td>
</tr>
<tr>
<td>DOC(cm)</td>
<td></td>
<td>100</td>
<td>60</td>
<td>89</td>
<td>53</td>
<td>35</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DAO(cm×cm)**</td>
<td>18×22</td>
<td>15×15</td>
<td>19×20</td>
<td>17×25</td>
<td>17×20</td>
<td>17×25</td>
<td>12×21</td>
<td></td>
</tr>
<tr>
<td>DAB(cm×cm)**</td>
<td>40×45</td>
<td>28×33</td>
<td>35×40</td>
<td>32×56</td>
<td>35×35</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COD ⑧</td>
<td></td>
<td>N</td>
<td>N</td>
<td>NW</td>
<td>NE</td>
<td>E</td>
<td>S</td>
<td>E</td>
</tr>
<tr>
<td>ACO (°)</td>
<td></td>
<td>&lt;90</td>
<td>&gt;90</td>
<td>90</td>
<td>&gt;90</td>
<td>&lt;90</td>
<td>&gt;90</td>
<td>90</td>
</tr>
</tbody>
</table>


* In statistic analysis, we treat the descriptive variables to numeric as following:
  ① poplar=1, elm=2  ② farm=1, forest=2  ③ none=1, yes=2  ④ <45° =1, >45° =2  ⑤ mid=1, top=2
  ⑥ E=1, NE=2, N=3, NW=4, W=5, SW=6, S=7, SE=8  ⑦ limb=1, trunk=2  ⑨ <90=1, 90=2, >90=3

** In statistic analysis, we divide the variables of DAO & DAB into DAO_S, DAO_L, DAB_S and DAB_L which represent the shorter diameters and longer diameters at the opening and bottom of a cavity respectively.
We analysed all these data of Scaly-sided Merganser nest cavities with Factor Analysis (SPSS 16 software) trying to find some key factors affecting on the Scaly-sided Merganser to select nest site, as well as made an integrative judging to each Scaly-sided Merganser nest cavity. This judgement may be described as which cavity is most likely be selected by Scaly-sided Mergansers. The descriptive statistics of each parameter are given in Table 8.

With factor analysis, we extracted 6 components according to Table 9. From Table 10, we may find the 1st component could represent the variables of position of cavity, habitat surrounding the tree, slope grading under the tree and the diameter at breast hight. The 2nd could represent species of the cavity tree, angle of the cavity opening, depth of the cavity. The 3rd component could represent the longer diameter at the bottom of the cavity and whether there are obstacles higher than the cavity in 10 m in the direction of the cavity opening. The 4th may mostly reflect the variables of the distance from the tree to the nearest river stretch and the altitude. The 5th could reflect the shorter diameter at the bottom, and the 6th the slope position.
Table 9: Total Variance Explained

<table>
<thead>
<tr>
<th>Component</th>
<th>Initial Eigenvalues</th>
<th>Extraction Sums of Squared Loadings</th>
<th>Rotation Sums of Squared Loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>% of Variance</td>
<td>Cumulative %</td>
</tr>
<tr>
<td>1</td>
<td>6.375</td>
<td>35.417</td>
<td>35.417</td>
</tr>
<tr>
<td>2</td>
<td>3.473</td>
<td>19.296</td>
<td>54.713</td>
</tr>
<tr>
<td>3</td>
<td>2.967</td>
<td>16.482</td>
<td>71.195</td>
</tr>
<tr>
<td>4</td>
<td>2.192</td>
<td>12.178</td>
<td>83.373</td>
</tr>
<tr>
<td>5</td>
<td>1.909</td>
<td>10.606</td>
<td>93.979</td>
</tr>
<tr>
<td>6</td>
<td>1.084</td>
<td>6.021</td>
<td>100.000</td>
</tr>
<tr>
<td>7</td>
<td>3.383E-16</td>
<td>1.879E-15</td>
<td>100.000</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>18</td>
<td>-5.244E-16</td>
<td>-2.913E-15</td>
<td>100.000</td>
</tr>
<tr>
<td>Extraction Method: Principal Component Analysis</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

With the factor score and the percentage to the variance of each factor extracted, we got the calculation formula to make an integrative ranking judge to all the 7 nest cavities:

\[ zF = 24.79 \times \text{fac1} + 20.87 \times \text{fac2} + 16.47 \times \text{fac3} + 15.51 \times \text{fac4} + 12.25 \times \text{fac5} + 10.11 \times \text{fac6} \]

The judge result is given in Table 11.

We presumed that the higher a cavity ranks, it would be more preferably selected by the Scaly-sided Merganser. But as lacking of samples of Scaly-sided Merganser nest cavities, we can not provide a method to test. According to our experiences of looking for the wild nests of the Scaly-sided Merganser in this year, we feel the following factors could be more important for a Scaly-sided Merganser selecting natural tree cavity to nest:
### Table 10_Rotated Component Matrix of Factor Analysis

<table>
<thead>
<tr>
<th>Component</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>POC</td>
<td>.917</td>
<td>.229</td>
<td>.251</td>
<td>-.207</td>
<td>-.016</td>
<td>-.031</td>
</tr>
<tr>
<td>HAB</td>
<td>.917</td>
<td>.229</td>
<td>.251</td>
<td>-.207</td>
<td>-.016</td>
<td>-.031</td>
</tr>
<tr>
<td>GRD</td>
<td>.901</td>
<td>-.011</td>
<td>-.404</td>
<td>-.141</td>
<td>-.058</td>
<td>.052</td>
</tr>
<tr>
<td>DBH</td>
<td>-.741</td>
<td>-.656</td>
<td>.046</td>
<td>-.062</td>
<td>.102</td>
<td>.061</td>
</tr>
<tr>
<td>HOC</td>
<td>-.572</td>
<td>.242</td>
<td>-.476</td>
<td>.469</td>
<td>-.390</td>
<td>-.128</td>
</tr>
<tr>
<td>SOT</td>
<td>.180</td>
<td>.912</td>
<td>.058</td>
<td>-.116</td>
<td>-.342</td>
<td>.034</td>
</tr>
<tr>
<td>ACO</td>
<td>.239</td>
<td>.912</td>
<td>.063</td>
<td>-.245</td>
<td>.180</td>
<td>-.120</td>
</tr>
<tr>
<td>DOC</td>
<td>-.128</td>
<td>-.754</td>
<td>-.071</td>
<td>.338</td>
<td>.011</td>
<td>-.543</td>
</tr>
<tr>
<td>DAB_L</td>
<td>.052</td>
<td>-.161</td>
<td>.963</td>
<td>.128</td>
<td>-.123</td>
<td>-.113</td>
</tr>
<tr>
<td>OCD</td>
<td>.023</td>
<td>.339</td>
<td>.927</td>
<td>-.094</td>
<td>.059</td>
<td>-.117</td>
</tr>
<tr>
<td>DAO_L</td>
<td>.555</td>
<td>.058</td>
<td>.587</td>
<td>.341</td>
<td>.096</td>
<td>.467</td>
</tr>
<tr>
<td>DTR</td>
<td>-.249</td>
<td>-.316</td>
<td>.082</td>
<td>.891</td>
<td>.116</td>
<td>-.157</td>
</tr>
<tr>
<td>ALT</td>
<td>-.404</td>
<td>-.126</td>
<td>.019</td>
<td>.853</td>
<td>.225</td>
<td>-.206</td>
</tr>
<tr>
<td>DAB_S</td>
<td>.306</td>
<td>-.618</td>
<td>.046</td>
<td>.689</td>
<td>.074</td>
<td>.202</td>
</tr>
<tr>
<td>DAO_S</td>
<td>-.023</td>
<td>-.354</td>
<td>.211</td>
<td>.156</td>
<td>.897</td>
<td>.030</td>
</tr>
<tr>
<td>ASP</td>
<td>.433</td>
<td>-.122</td>
<td>.303</td>
<td>-.090</td>
<td>-.717</td>
<td>-.429</td>
</tr>
<tr>
<td>COD</td>
<td>.411</td>
<td>.377</td>
<td>-.361</td>
<td>.265</td>
<td>.657</td>
<td>.238</td>
</tr>
<tr>
<td>SP</td>
<td>-.045</td>
<td>-.062</td>
<td>-.168</td>
<td>-.186</td>
<td>.204</td>
<td>.943</td>
</tr>
</tbody>
</table>

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 10 iterations.

### Table 11_The Result of Integration Judge to the Scaly-sided Merganser Nest Cavities

<table>
<thead>
<tr>
<th>Cavity</th>
<th>S_1</th>
<th>S_2</th>
<th>S_3</th>
<th>S_4</th>
<th>S_5</th>
<th>S_6</th>
<th>S_7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rank</td>
<td>3</td>
<td>6</td>
<td>4</td>
<td>2</td>
<td>7</td>
<td>1</td>
<td>5</td>
</tr>
</tbody>
</table>

1. **Obstacles** - The sprout branches or branches of other trees cover or surrounding the cavity opening may increase the difficulty for a Scaly-sided Merganser entering into the cavity. We checked many cavities surrounded by branches, even other factors, such as the diameter of opening, depth, and location are suitable, but none of them are occupied by Scaly-sided Mergansers or Mandarin Ducks. The high trees nearby in the direction of the cavity opening could be also obstacles to Scaly-sided Mergansers. Except the cavity S_4, all the other 6 cavities are higher than the plants nearby and clear of obstacles in the
cavities directions. About 6 m away from cavity S_4, stands a tree higher than S_4 in the
direction of its opening. But there is much space between the higher tree's crown and the
cavity S_4. So Scaly-sided Merganser can still fly bypass this obstacle. Cavities S_1, S_2
and S_5 are on the trees standing at the edges of farms. They can be found in far distance
very easily.

2. Distance to the nearest river stretch - The cavity S_1 we monitored from 2006 is 1.17
km away from the nearest stretch. It had been used as nest by Scaly-sided Merganser for
many years, but it is abandoned in this spring. The nearest stretch was cut off for the
construction of a new water-power station. We suppose this is the direct reason. The
same river still flows in upper reach and lower reach where are only about 2 or 3 km
away from the cavity S_1. It would rather abandon this nest site than fly a little bit longer.
There must be some reason for this. Except cavity S_1, all the other 6 cavities are found
near rivers - 95 m in average distance to the nearest river.

3. The matter at the bottom - We checked some nest cavities. The matter at the bottom is
mainly a little of humid rotten wood chipping. It is said that in Heilongjiang province,
somebody put some sawdusts into a Scaly-sided Merganser nest cavity to elevate the
bottom, but this cavity has never been used again by Scaly-sided Merganser after that.

4. Angle of the cavity opening - The angle of the cavity opening to the ground should be
important. If it is elevation, it would be easy for the rain water to get into the cavity and
this could affect the hatching of eggs. The opening angles of cavities S_2, S_4 and S_6 are
bigger than 90°, but only the angle of S_2 is about or a little bigger than 135°. The angles
of S_4 and S_6 are about 120°. The angles of the other 4 cavities (S_1, S_3, S_5 and S_7) are
perpendicular or depressed. The correlation among the opening angle, neat humidity and
the incubation rate should be focused in future study.

5. The diameters of the opening and the bottom - We suppose that the shorter diameter of
an opening may affect a Scaly-sided Merganser entering into the cavity. A big opening
could possibly cause the quick loss of thermo in the nest. We once checked a cavity on
the trunk of an elm tree in last spring. The diameter is about 30cm and the depth 45cm,
opening perpendicular. This cavity tree is located at the forest edge and only 10m to the
river and the cavity is very obvious to be seen from the middle of river. But there were
not any signs of being occupied by Scaly-sided Merganser or Mandarin Duck in this
cavity. The diameter at the bottom may affect the coziness of a hen when she sits in the
nest. Our factor analysis result (Table 9) shows that the shorter diameter of opening and
the longer diameter of the bottom are the main factors for Scaly-sided Merganser to select
nest site. The means of diameters at openings and bottoms are 16.43cm×21.14cm and
34cm×41.80cm.
During the second half of August, we made repeat surveys on the brood densities in 9 river stretches. The data of survey result and the comparison to the last year are given in Table 12 and 13. In summer survey, we totally counted 35 broods and 4 amalgamated broods. These amalgamated broods were found in sizes of 17, 22, 29 and 34 in Manjiang, Songjianghe and Fuerhe. We calculated the average size of 35 Scaly-sided Merganser

<table>
<thead>
<tr>
<th>River</th>
<th>Distance</th>
<th>Survey Date</th>
<th>Individuals</th>
<th>Estimated Broods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xilinhe</td>
<td>27</td>
<td>Aug. 16</td>
<td>32</td>
<td>4</td>
</tr>
<tr>
<td>Manjiang</td>
<td>51</td>
<td>Aug. 17–18</td>
<td>150</td>
<td>19</td>
</tr>
<tr>
<td>Songjianghe</td>
<td>34</td>
<td>Aug. 19</td>
<td>78</td>
<td>11</td>
</tr>
<tr>
<td>Fuerhe</td>
<td>36</td>
<td>Aug. 20</td>
<td>106</td>
<td>12</td>
</tr>
<tr>
<td>Erdao_Sjiang</td>
<td>29</td>
<td>Aug. 21</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>Erdaobaihe</td>
<td>12</td>
<td>Aug. 22</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Hongqihang</td>
<td>32</td>
<td>Aug. 23</td>
<td>11</td>
<td>1</td>
</tr>
<tr>
<td>Hunjiang_Lower</td>
<td>29</td>
<td>Aug. 25</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Yalu_Jian</td>
<td>40</td>
<td>Aug. 26</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>290</strong></td>
<td></td>
<td><strong>392</strong></td>
<td><strong>49</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Xilinhe</td>
<td>42</td>
<td>32</td>
<td>5</td>
<td>4</td>
<td>1.400</td>
<td>1.185</td>
<td>0.167</td>
<td>0.148</td>
<td>30</td>
<td>27</td>
</tr>
<tr>
<td>Manjiang</td>
<td>98</td>
<td>150</td>
<td>5</td>
<td>19</td>
<td>3.267</td>
<td>2.941</td>
<td>0.433</td>
<td>0.373</td>
<td>30</td>
<td>51</td>
</tr>
<tr>
<td>Songjianghe</td>
<td>171</td>
<td>78</td>
<td>19</td>
<td>11</td>
<td>4.275</td>
<td>2.294</td>
<td>0.475</td>
<td>0.324</td>
<td>40</td>
<td>34</td>
</tr>
<tr>
<td>Fuer River</td>
<td>105</td>
<td>106</td>
<td>13</td>
<td>12</td>
<td>2.234</td>
<td>2.944</td>
<td>0.277</td>
<td>0.333</td>
<td>47</td>
<td>36</td>
</tr>
<tr>
<td>Erdao_Sjiang</td>
<td>12</td>
<td>15</td>
<td>2</td>
<td>2</td>
<td>0.414</td>
<td>0.517</td>
<td>0.069</td>
<td>0.069</td>
<td>29</td>
<td>29</td>
</tr>
<tr>
<td>Toudao_Sjiang</td>
<td>15</td>
<td>2</td>
<td>0.342</td>
<td>0.053</td>
<td>38</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Songjiang</td>
<td>4</td>
<td>1</td>
<td>0.154</td>
<td>0.038</td>
<td>26</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Erdaobaihe</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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<td>Hongqihang</td>
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<td>0.344</td>
<td>0.031</td>
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<td><strong>Total/Mean</strong></td>
<td><strong>445</strong></td>
<td><strong>392</strong></td>
<td><strong>55</strong></td>
<td><strong>49</strong></td>
<td><strong>1.099</strong></td>
<td><strong>1.136</strong></td>
<td><strong>0.139</strong></td>
<td><strong>0.142</strong></td>
<td><strong>356</strong></td>
<td><strong>290</strong></td>
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broods, and used this mean to estimate the brood numbers composed each amalgamated broods. The mean brood size is $7.49 \pm 2.98$, a little bit less than that of last year - $7.83 \pm 2.92$.

We estimated that the 4 amalgamated broods were composed by 14 Scaly-sided Merganser broods. The bird and brood densities of Scaly-sided Merganser in summer of 2009 in Changbai Mountains are $1.136 \pm 1.26$ birds/km and $0.142 \pm 0.158$ broods/km. From Table 13, we can find that both the bird and the brood densities of Scaly-sided Merganser in summer of 2009 are a little bit higher than those of 2008. This is because we surveyed more sparse rivers to the Scaly-sided Merganser densities in the summer of 2008. From Chart 2, we can find that only in Songjianghe, the brood density decreased significantly in 2009. We assumed that the enhanced people disturbance is the main reason to this decreasing. Two big profitable boat-drifting companies were established along the middle reach of this river.

![Chart 2_Scaly-sided Merganser Brood Densities in 5 Rivers Surveyed in 2008 & 2009](image)

**PART FIVE - THREATS**

At present, the most important threat to the Scaly-sided Merganser in Changbai Mountains is habitat degrading and lossing caused by people disturbance and destroys to the habitat.

**Profitable Rubber-boat Drifting**

Most profitable rubber-boat drifting companies were established in the breeding ground of Scaly-sided Merganser. Every year, these drifting places attract huge visitors in summer. Most of the visitors do not know this globally threatened species and most of them are very strange to the wildlife emerged in the river. They may chase or even attack the Scaly-sided Merganser sometimes. Even worse, in all the rubber-boat drifting places, there were not any warning words or marks or even any oral warning to visitors for not chasing and attacking the wildlife they meet when drifting. Up to now, more than 30% of the rivers in Changbai Mountains have profitable rubber-boat drifting activities. To our best knowledge, the total length of the rubber-boat drifting stretches may approach 100km - 1/3 of the the best habitat of Scaly-sided Merganser in Changbai Mountains. We estimated that the total length of the Scaly-sided Merganser habitat in Changbai
Mountains possibly is not longer than 1000km and the best habitat may not exceed 300km.

**Digging Sands**  
With the enhancing development to the Changbai Mountain, sand become a very short resources. Under the driving of profits, many people invest to dig sands from rivers. Even we could not prove it (some Scaly-sided Mergansers still live at the remnant sites of digging sands), but we still suspect digging sands destroys the river bed and might affects the fish community structure, further more might affects the food of Scaly-sided Merganser.

**Killed by Net**  
Pic 1 and 2 describe a trap net used by local people to catch fishes and frogs. As its shape is much like a sleeve, so it is named as sleeve net. Even we have not seen for ourselves how this net may catch Scaly-sided Merganser (especially ducklings), but we can often hear the stories of how this kind of nets caught the broods of Scaly-sided Merganser.
PART SIX - CONCLUSION

Our survey results show that the numbers of Scaly-sided Merganser in Changbai Mountain Range decreased a little in 2009, comparing with that in 2008. The abnormal climate in this year might be a reason, but the main reason still comes from the enhancing development to the Changbai Mountain.

According to our studies on the Scaly-sided Merganser in Changbai Mountain range, we estimated that the Scaly-sided Merganser habitat in Changbai Mountain range could be not longer than 1000km. So if we use this digit as a base of estimation, we could give out the estimation of the Scaly-sided Merganser population in Changbai Mountain range in 2009 - 160-260 pairs, 120-164 broods. We suspect this result is still over estimated.