Magnolia stellata *in its native habitat in Japan*

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Magnolia stellata is a most attractive plant with good climatic hardiness, well suited for cultivation in many parts of the world, including southern Scandinavia. The range of flower colors, size of plants, and growing conditions in nature has been shrouded in some mystery, though. In addition to the wish to understand these fundamental facts, we in the Swedish Magnolia Group, have also an interest to further investigate the possibilities of using the compact size and red tepal color of some forms of *M. stellata* in developing compact growing hybrids of attractive colors. Existing examples seem promising, for example *Magnolia* 'Gold Star.'

The knowledge in the west about *Magnolia stellata* has been very limited for a long time. First-hand detailed investigations of geographical distribution have been made only comparatively recently (Ueda 1988, JASC 1996). The name of this plant and even whether to treat it as a species in its own right or as a sub-species or variety of *Magnolia kobus* has been controversial. Ueda (1986) has proposed that the name should be *M. tomentosa* Thunb. but the name *Magnolia stellata* has been preserved by Nooteboom (1994) since the name *Magnolia tomentosa* had been published earlier as the basionym for *Edgeworthia tomentosa.* (This has been subsequently supported by Spongberg (1998).) As a compromise I will sometimes use the Japanese name *Shidekobushi* for *Magnolia stellata* in this report. *Shide* is the Japanese name for the zigzag paper strips used for different purposes in the Shinto religion. These strips can be seen hanging on horizontal ropes in shrines (Figure 1) and also attached to the top of a wooden pole to form a broom used by Shinto priests for ritual cleaning and sweeping away of evil spirits. The second use in particular, as a broom with zigzag strips is indeed quite a suggestive comparison with opening of certain flowers of *M. stellata* (Figure 2) (Itoigawa and Yamaguchi 2007). *Kobushi,* the Japanese name of *M. kobus,* means *clenched fist,* referring to the form of the seed.

The Japan Association for Shidekobushi Conservation (JASC 1996) is conducting extensive and ongoing investigations of the natural distribution through Dr. J. Itoigawa and other members of the Association. Geological and hydro-geological aspects have been studied (Itoigawa 2004 and 2007). Protection plans and practical measures have been implemented by several local authorities.

Figure 1. Shide at a small shrine.

This report has not the ambition of a strict scientific paper but should be seen as a list of observations, a collection of more or less proven facts, and several questions.

As early as 1976, the late Swedish dendrologist Tor Nitzelius paid a short visit to at least one of the Shidekobushi locales in the Atsumi peninsula. A private communication to Dr. Karl Flinck reached Neil Treseder just in time to be included as a note in his book *Magnolias* (Treseder 1978). More recent brief reports have been given by Jim Gardiner (Gardiner 2000 and 2002).

Figure 2. Opening flower of Shidekobushi.

The spectacular flowering of *M. stellata* is the most important character in discovering stands in nature. The showiness and variation of the flowers (color, number of tepals, size, etc.) is very interesting and contributes to the appreciation of the species by the public. Thus, my tour was planned to coincide with the flowering period, which is late March to about two weeks into April, but with some variation according to weather conditions. Although my planning, including the time frame, had to be made well in advance, I was lucky to be just in time for the flowering in the different areas.

The area of distribution of *M. stellata* is around the Ise Bay, within the prefectures of Mie, Aichi and Gifu. (See map, Figure 3.) Three sub-areas can be distinguished: Atsumi peninsula in the south (clearly isolated from the rest), northern Mie (also clearly segregated from the rest) and a third, larg-

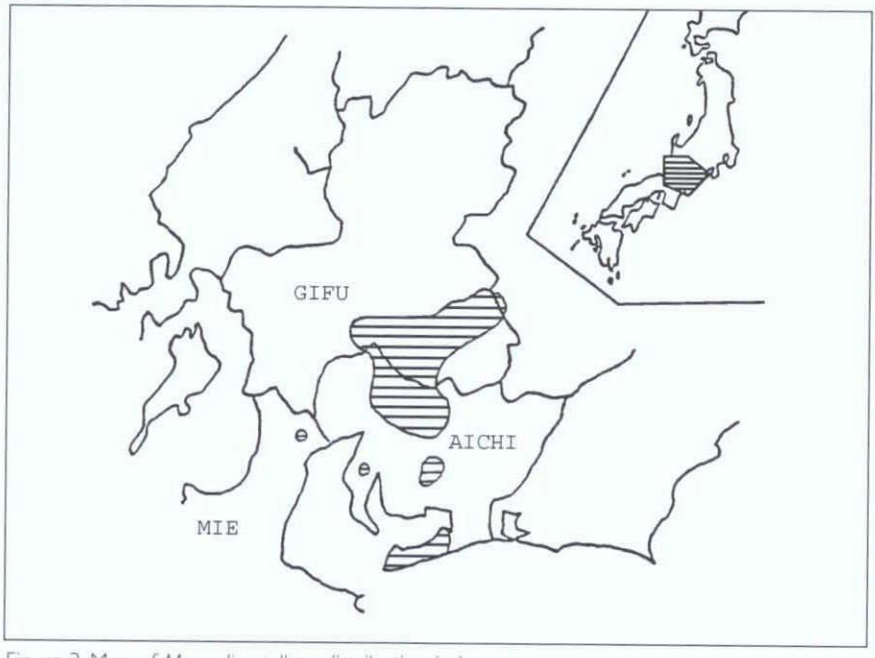


Figure 3. Map of *Magnolia stellata* distribution in Japan.

er region from Gifu city in the west and east-northeast to Sakashita at the border of Gifu and Nagano prefectures and south to Toyota city. This third area is topographically variable but the larger part of it is the Tono (Tajimi, Toki, Mizunami, Ena, and Nakatsugawa) area. The most interesting question of whether these geographically differing regions are also reflected in the genetic status of the Shidekobushi populations has been studied using allozyme analysis (Nakajima 2003), and with nuclear and chloroplast microsatellite markers (Ueno et al 2005). The results are, in short, that the three areas mentioned above are also genetically apart, and further, that three genetically different sub-regions can be distinguished in the Tono area.

The occurrence of Shidekobushi in this limited area of Tokai (Aichi, Gifu, Mie, (and Shizouka)) is remarkable. It has been suggested (Hara 1959) that marshy places in the area can be seen as relic habitats for several boreal plants from the last glaciation. Shidekobushi should perhaps not be called a boreal plant, but it shows a remarkable climatic tolerance to much colder climates when grown in other parts of the world (and Japan). Most of the broad-leaved forest species of the Tokai area are adapted to and require a much milder climate. Nagoya, in the lowlands, has a mean temperature of 39°F (4°C) for the coldest month (January) and 81°F (27°C) for the warmest month (August).

My route and schedule in the spring of 2007 was planned to cover a sample of locales for Shidekobushi and at the same time follow the floral development of the season. It was very gratifying that this plan worked so well.

In this report I will describe and comment on locales in (almost) the same order as I visited them. Information on positions refers to the maps in the report of the Japanese Association for Shidekobushi Conservation (JASC 1996).

Atsumi peninsula

This is the southernmost area of the Shidekobushi distribution and consists of very flat, low-lying land [typically 30–160ft (10–50m) above sea level], with a few scattered mountaintops. Most of the area of flat land is intensely cultivated for vegetable crops with a lot of irrigation and extensive greenhouse complexes. One must assume that wetland suitable for and harboring natural vegetation, including Shidekobushi, was once much more prevalent but was drained and cultivated a long time ago. Shidekobushi flowers are pollinated by insects (small beetles) and the seven population groups of the Atsumi peninsula marked in the maps of the JASC book must be regarded as isolated from each other. It is a delicate question if, for conservation activities, any artificial interbreeding between these groups should be allowed; more genetic investigations are needed. See Hirayama et al (2005).

In some instances, I noticed places close to the mountains where farming land has been abandoned and reeds and brush are taking over. It did occur to me that some of these places might be suitable for the reintroduction of Shidekobushi, if the incentive and resources are available. In that case, only seed or plants from closely neighboring sites in the Atsumi peninsula should be used, of course, and more extensive genetic mapping of different stands should probably be made beforehand.

Kurokawa wetland

This site has been protected since 1971 and seems to be well researched and under full control. As early as the 1500s, it is mentioned in Tawara-ki (book of records) that this marshland area, fed by spring water from a small plateau, contained Shidekobushi. The site is well defined by a sturdy fence although it is closely surrounded by piggeries and cultivated fields. Any accidental emission of poisonous substances from the surrounding activities (like manure storage tanks) could be disastrous. Possibly the hydrological balance is delicate but otherwise this locale looks safeguarded. Many Shidekobushi of old and middle age are easy to observe but there seems to be no regeneration, although I might have missed some. Anyhow, there is not much place for new saplings to develop. The plank bridge across the marsh is excellent for observations (see Figure 4). There is a wide variation in color and number of petals of the magnolias and all plants are of

Figure 4. Kurokawa swamp "Botanical Garden," Atsumi peninsula.

the twiggy, fine-branched type. One plant in the middle of the wetland (medium size, rose color) has its base only about 4in (10cm) above the water level on a very small mound. I found it surprising that it can grow so well with its roots immersed in water. Possibly the water level is slightly lower when the surrounding vegetation is growing actively. Also, there is a continuous very slight slope, as far as I could judge, so the water is constantly moving.

At the eastern perimeter there is a large old plant with lots of exceptionally small white flowers. I have not seen any similar flowers of Shidekobushi in any other natural stand, but it was quite impossible to get close to this plant for detailed inspection.

Nagusa

This place is at the foot of the mountain where it meets the plain and is a most attractive glade. It has recently been managed with fences and some thinning of the vegetation along the edges of the stand. It shows the same type of compactly growing specimens, except near the boundaries where lack of light has made some plants go up in height (see Figure 5). At Kurokawa the compact size could possibly be partly due to exposure to strong winds but here the site is very well protected from all directions and the compact mode of growth must be due to genetic factors, although examples show that they do have the ability to increase considerably in height to reach more light.

Figure 5. Compact growing *Magnolia stellata* with rose-colored flowers at Nagusa, Atsumi.

The ground is moist but sloping and not nearly as wet as at Kurokawa. At flowering time I could observe a sward of dead grass and I suppose in summer there is a thick growth of grasses, which could make regeneration difficult. There is a reasonable age variation but I did not observe any saplings.

Ikawase

This is the home of a rather special group of Shidekobushi. It is a long row of plants of similar age along a small straight road. It could be the remains of an older natural stand but to me it seems quite likely they have been planted there. Perhaps some elderly person in the vicinity might remember the history? The distance to the Nagusa stand (see above) is only 1600ft (500m) but there is open farmland between.

Northwest Atsumi

I also visited the locale marked on page 187 of the JASC 1996 book [34 37 30.4 N, 137 07 13.9 E, 295ft (90m) altitude]. This is on a north-facing hillside and rather steep. It was quite difficult to locate any Shidekobushi but eventually, just before giving up, I found a few (although the JASC map says 500 plus plants!). They were growing on a steep, stony, moist scree, in shadow of other vegetation and very straggly due to lack of light (see Figure 6). It would have been virtually impossible to find them out of flowering season. Unless I missed a lot, and I don't think I did, this locale is in great danger of extinction and should be managed by careful thinning. Some very discreet markings showed that the place had been visited at one time for some kind of study.

Tousitibara wetland

This locale is on the northwestern outskirts of Tahara city and is quite easily accessible with parking places and good sign posting.

Figure 6. *Magnolia stellata* in an overshadowed stand in NW Atsumi peninsula.

It is a dense stand with many plants and an interesting variation of morphological traits. The general impression is of compact growing types of Shidekobushi. The place has obviously been managed by some thinning of unwanted vegetation and fences to keep spectators in check. The place looks a bit worn though, due to many visitors, but I guess this is only for a very limited period of time during flowering and it would be a real pity to deny the public of this marvelous sight. A strict management program seems necessary.

Northern Mie prefecture

The four main locales in this area don't contain very many plants, perhaps less than the Atsumi peninsula. Still, the area is very important as the earlier-mentioned genetic investigations show that there are definite differences in these isolated locales compared to the other main areas. I did not visit the Daian-cho (Inabe) locales marked in JASC p. 193.

The northern-most place marked on JASC p. 190 does not seem to have any Shidekobushi now. After hunting around for some time I asked a local man, also showing him Shidekobushi pictures, but he denied that there were any at that place, although he mentioned one or two of the other locales further south showing that he was well aware of the meaning of my question.

The three other places in the Mie prefecture that I visited are described below. Generally, I got the impression that the Shidekobushi of northern Mie are not as compact in growth as those from the Atsumi region but not quite as tall and strong growing as those from the Tono area to the northeast.

Yokkaichi 1

Yokkaichi 1 (JASC p. 191) is a very small stand consisting of a group of about a dozen plants, where a wooded hillside joins a flat open area and water seeps out from the slope. It is easily accessible and a little picnic place with rustic seats has been prepared nearby, but the terrain did not look much

Figure 7. Evenly pink-colored *Magnolia stellata* at Yokkaich 1 locale, Mie.

worn by people. The color of the flowers is a very nice pink and evenly distributed on the outside of the petals (no stripes). (See Figure 7.) A small stand like this is vulnerable and should perhaps be assisted by measures to facilitate natural seed germination.

Yokkaichi 2

Yokkaichi 2 (lower circle on map JASC p.190) is very well hidden and probably little known among the public. I had some difficulty finding it and had to ask for a way down into this heavily vegetated valley. I was kindly shown the approximate direction but got a comment that it was difficult: "no path." It was not possible to get down into the valley from the north because there is a rock precipice several meters high and from the west there is a young, very dense *Cryptomeria* plantation. It was possible to go down the steep south side from a path running along the edge. It might also be possible to follow the stream (upstream direction) from the east. The valley is about 60ft (20m) deep compared with the surrounding land and the Shidekobushi are growing at the foot of the steep southern bank and a bit out on the gently sloping valley bottom.

As expected, this ground is wet and in a couple of places it was possible to see that it consisted of clay-ey coarse gravel. Some features on the ground make me believe that it has at some time been used for agriculture. Several Shidekobushi plants are marked with colored bands or number labels from some earlier or ongoing investigation. It is quite dark down there, due both to the high steep bank to the south and to competing vegetation (mainly deciduous but also some pines). A little, very little, thinning could be seen. As a result of these conditions, and possibly for genetic reasons, many very high and thick stems of Shidekobushi were observed. It was also gratifying to see some saplings, and I think the moist and bare surface (no grass) is very good for seed germination and the start of sapling growth.

In my opinion, this is a very promising and valuable locale without any obvious competing use. As mentioned, there is an area of planted *Cryptomeria* in the valley just to the west but the place could hardly be attractive for housing or industrial development. The fair amount of plants should mean a reasonable genetic variability. The site is well protected from high winds and it is not very easily accessible to the public. The main conservation work should be a gradual, careful thinning of competing vegetation and tending

of natural regeneration. The area of Shidekobushi could very probably expand naturally if the possibilities are created. Hopefully, the interest and resources can be mobilized.

Komono

In contrast to the locale just described above, Komono (JASC p. 192), has been well taken care of. It is well marked, ample information is presented and even an inscribed stone monument has been erected at the roadside. Proper thinning has been made on the slopes around the wetland, sensitive areas roped off, and a sloping observation platform has been built on the edge of the wetland. The Shidekobushi plants are of medium height and have a full range of color from white to rose (see Figure 8). Places to scrutinize for regeneration were not accessible but I see no reason that it should be difficult. Provided the hydrogeology of the surrounding area is not changed, I think the future is good for this place.

Figure 8. Protected marsh (National Monument) with *Magnolia stellata* at Komono, Mie.

Tono and adjacent areas

This is a very wide area with a lot of Shidekobushi locales with still more being discovered. Their altitudes vary from about 300ft (100m) up to almost 2,300ft (700m) above sea level. The general trend is that Shidekobushi plants growing at higher altitudes also are taller. Why it should be so is not clear to me, but it is an intriguing question. One suggestion (Ogishu, private communication) is that there is a genetic influx from adjacent *Magnolia* species growing at higher altitudes, primarily from what is now classified as *M. salicifolia* (and possibly *M. kobus*). We must bear in mind that taxonomy is only a crude map to reality, not the other way around, and that both a wider and more continuous variation is found in nature than the flora textbooks often make us believe.

In the nursery of Mr. Yamaguchi, located north of Mizunami, I was shown what is considered very likely a natural hybrid between Shidekobushi and *M. salicifolia*, the original plant of the clone 'Robert's Dream' named after Robert de Belder of Kalmthout (see below for some information about natural hybrids).

Seto

This area does not belong to the Tono area proper but is a little further southwest. During the planning of the 2005 Aichi Expo, the nature conservation aspects of this area were subject to heated controversies. One reason was the prospect of loosing important Shidekobushi locales. Obviously the plans were gradually modified and a thorough botanical and geological investigation was required. The final outcome in terms of environmental influence is not known to me.

The type of Shidekobushi here seems to be fairly weak growing with a tendency to compact habit when enough light is available, which it often isn't.

The first locale I looked for was the top left of JASC map (p. 155). It is the right type of place for Shidekobushi but is rather overgrown; I did not find any plants. There may be a few but I doubt it. This might be an example where abandoned rice fields were colonized by Shidekobushi for a limited time before being overgrown by other vegetation.

Next, I went a little south to some of the locales in the middle of the JASC map (page 155). They overlap to some extent and I could not easily distinguish them in nature. This is where an investigation on natural vegetative regeneration was made (Gotoh et al 1998).

The landscape consists of several gravel ridges with small moist valleys in between. Quite a few Shidekobushi are growing in places that are too dark. In my opinion, the plants are under stress and are held back by competing vegetation. To promote the Shidekobushi plants, I think some careful thinning should be made, but I understand that the area (after the thorough discussion around the Expo issue) is under a general management plan and that there are competing conservation interests concerning other vegetation.

Tajimi

Many stands and fragments of stands are to be found in and around the city of Tajimi. One example is a couple of substantial Shidekobushi areas at Kokeizan (JASC p. 91, lower left corner), probably safeguarded by growing on land belonging to a temple.

Another example is a couple of rather large Shidekobushi trees at Ikta growing on different sides of and very close to a busy main street (35 20 15.0 N,

137 08 22.6 E). These are obviously relics from old natural stands. These two trees are said to be the first to flower in spring in Tajimi.

A third example is a small valley in front of the modern buildings of the impressive ceramics museum of Tajimi. The valley has been spanned by an entrance bridge and the beautiful Shidekobushi vegetation of the valley is preserved or restored. It is a lovely sight. As a showcase for Shidekobushi, it is outstanding.

Toki

North of Toki city are some very good Shidekobushi stands (JASC p. 70, the two big overlapping circles). (See Figure 9.) This is perhaps the most impressive of all the Shidekobushi sites I saw on the whole tour. Walking uphill northwards from the railway station, passing the last housing estate I followed a new northbound road. To the west of the road is a very large area, perhaps half a square kilometer, which has been leveled to a plain, in preparation for the building of new housing estates. At the edge of this field is an area, about 100 × 100ft (30 × 30m), where plants have been collected, possibly due to legal obligation, obviously from sites destroyed in the vicinity. Surprisingly large *Acer pycnathum* trees had been (temporarily, no doubt) transplanted and re-established to this area together with many Shidekobushi plants of various sizes. When I passed the place it was care-

Figure 9. North of Toki, Gifu. A substantial stand of *Magnolia stellata*.

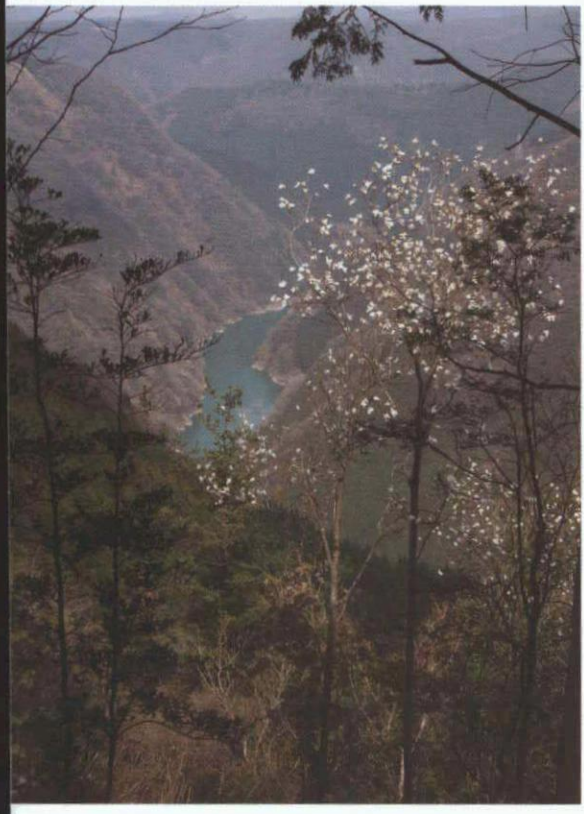
fully irrigated from a tank on a small truck. Let's hope these plants will soon find new and good homes!

Soon after that, half a mile (1km) northwest, is the beginning of two very substantial wetlands, each having very large populations of Shidekobushi. They are of comparatively low growth, particularly, of course, where they are not in the shadow at the edges of the wet areas. The surrounding ridges look dry and have rather poor vegetation with a lot of *Pinus*. The ridges consist of gravel, the infiltrating water being forced out sideways by layers of clay rather than bedrock (Itoigawa, private communication).

Flower color is the full range from white to rose and the age distribution of the plants looks good and natural.

I understand measures are underway to give these two areas a permanent protection and I could not agree more. At peak blooming time, you are looking at a sea of flowers: this is the jewel in the crown!

I suppose the landscape restructuring at lower levels to the south (mentioned above) has not had any impact on the hydrogeology but the situation must be carefully monitored and to the north an extensive golf course has been built some years ago, not close to the wetlands, though.



Mizunami

In this area I was shown several small and scattered groups of Shidekobushi between the city and the Kiso River. Here the altitude increases up towards 1,600ft (500m) and many small rice fields seem to have been abandoned as a result of modernized agricultural practices, which might give room for natural re-growth of Shidekobushi under favorable circumstances. At about 1,600ft (500m), *Magnolia salicifolia* was also found on the very steep slope down to the Kiso River (see Figure 10).

Figure 10. Overlooking Kiso River north of Mizunami. *Magnolia salicifolia.*

Ena, Nakatsugawa, and surrounding areas

Ena and Nakatsugawa cover a vast area where I had opportunities to see a variety of Shidekobushi stands, the common denominator being tall and very tall growing specimens, sometimes really substantial trees. About one and a half miles (2km) north of Minosakamoto station (JASC p. 26, approximately 35 29 34.3 N, 137 27 19.5 E) is a large and very well managed stand of Shidekobushi. This stand is well known and very much visited during flowering time. Plank bridges have been built to make the place accessible and to minimize erosion and damage to the ground. In my opinion, it is fully acceptable to make some showcases like this where Shidekobushi can be beautifully and instructively presented. On the other hand, this place looks rather static with little room for any natural development.

In the Hirakawa area (JASC p. 15, 35 30 59.6 N, 137 23 36.9E) I was shown an example of a large [33ft (10m) high] 8-stemmed Shidekobushi (maximum individual stem circumference [28in (72cm)]. This tree had developed freely without interference from surrounding vegetation, and was growing at the edge of a stream—a truly magnificent specimen (see Figure 11).

The largest Shidekobushi I ever saw, and as I understand quite possibly the largest in existence was just west of the Naegi Mineral Museum (which, by the way, is an extremely nice and well-managed museum). The position is JASC p. 28 upper right circle, approximately 34 32 31 N, 137 28 04 E. I joined members of a party from the annual JASC meeting at Naegi and we measured the height to 36ft (11m) and the circumference of the single stem at 62in (157cm) at breast height (see Figures 12 and 13). A real giant and a real beauty! I asked for any estimate of its age and was told "about 60 years." At first I found this an unbelievably low figure but it was explained to me that regular cutting of Shidekobushi plants along the edges of the rice fields in this area stopped when rice growing was given up about 60 years ago. Thus, these facts give a good chance to estimate the tree's age. A simple calculation gives an annual mean radial incre-

Figure 11. Dr. Junji Itoigawa measuring an impressive *Magnolia stellata*.

Figure 12. Record-sized *Magnolia stellata* north of Nakatsugawa, Gifu.

Figure 13. Flower from the record-sized *Magnolia stellata*.

ment of 0.16in (4mm), which is not at all exceptional for many tree species.

At Kono, NE of Nakatsugawa (JASC p. 29, lower circle, approximately 35 30 16.7 N, 137 31 32.6 E) are Shidekobushi stands close to the limit of its distribution. Here it meets *Magnolia salicifolia* and I was shown some plants supposed to be natural hybrids (see Figures 14 and 15). The appearance of the flowers was quite supportive to this idea but of course the leaves (which were not out at this time) must be examined and further genetic studies would be interesting. I was told that the hybrids are not fertile. I rather guess they should be at least partly fertile but mechanisms of decreased fertility of hybrids are well known and may prevent intermediate forms to take over large areas. Pollination problems might also limit fruit setting.

At the end of a long and most rewarding day around Nakatsugawa I was taken up to the snow at about 5,200ft (1,600m) altitude on Mt.

Figures 14 and 15. Two examples of *Magnolia stellata* flowers at Kono, Nakatsugawa; at least the one at top has been suggested to be a hybrid with *Magnolia salicifolia*.

Ena to fulfil my wish to see examples of *Magnolia sieboldii* (perhaps with an added subspecies *japonica*), which here is almost an alpine plant growing with *Sorbus*, and so forth, on steep slopes. Mr. Yamaguchi could pinpoint some *M. sieboldii* plants and we studied the winter buds and the rather straggly habit of growth.

Summary

The Shidekobushi plants

- Shidekobushi does grow in very wet places. As they do quite well on ordinary soils in cultivation the conclusion is that it is not a necessity but an exceptional ability to thrive with wet feet and that they have found an ecological niche where the competition with other vegetation is less severe. But do mind that this water is not stagnant and humus rich, but moving surface water rich in oxygen. There are examples from some locales in North America where magnolias thrive under similar circumstances. A note of caution, though: I have only seen the Shidekobushi locales in early spring and it is possible that the ground dries up partly when other vegetation is actively growing.
- The height of the Shidekobushi plants is obviously determined both by genetic factors and by the intensity of the light they receive. The size generally increases from Atsumi through Mie to Tono and also within the Tono area as you move northeast. This is, no doubt, due to evolutionary genetic factors but what are the driving forces for the natural selection?
- The whole range of flower color from pure white to rose-purple is found all over the area, usually in random mixture. I hesitate to suggest this as I have no firm proof and I expect to be contradicted, but I have a feeling that pink flowering plants have a tendency to flower somewhat later than the pure white forms.
- The rate of growth in Japan is much faster than expected based on European horticultural experiences. Hot summers and plenty of water in both ground and air could be the explanation. A three year old seedling in the Tokai area can flower and be as much as 5ft (1.5m) high (Yamaguchi, private communication).
- The number of tepals varies very much and flowers with 30 plus strap-like tepals are by no means the normal situation. Such specimens in western cultivation are obviously extreme selections.

Conservation issues

This is just a small list of ideas and questions. Objections are likely from those who make thorough investigations *in situ*.

- In some European environments, the increase in nitrogen compounds brought down by rain has stimulated the growth of grasses to such an extent that natural seed regeneration of some tree species is decreasing. In the Shidekobushi wetlands, I noticed a lot of dead grass from last year. Is this a problem?
- The area around the Ise Bay is heavily industrialized. This has no doubt resulted in emission of acid sulfur compounds reaching the soils. Acidification of soils is a serious problem in some parts of the world. How is the situation for Shidekobushi?
- The JASC has done extremely important work pointing to and increasing the awareness of destruction of Shidekobushi sites due to housing and industry development projects. The slower economic growth of Japan in the last decade seems to have lifted some of the threats but the continuous vigilance by JASC and its members is certainly of the greatest value and necessity. In 1990, an appeal was launched for support to stop land development in an important Shidekobushi locale near the city of Toyota (Yamaguchi 1990).
- The cultivation of rice seems to partly compete with Shidekobushi for similar environments. The area used for rice fields has obviously decreased, first, of course, on marginal sites. Could this perhaps lead to Shidekobushi reclaiming some sites? This might not happen automatically; destroyed ecosystems rarely return to their former equilibrium. Other species than Shidekobushi might be quicker to invade abandoned wetlands; I have seen examples on my tour. Are these problems discussed?
- I have already made several comments on the necessity of thinning, partly because the environmental conditions have changed and the Shidekobushi are no longer able to fight for room on their own but need some human assistance. However, too dramatic thinning might be detrimental. Sudden exposure to light and heat could harm the plants or other vegetation could respond more quickly and take advantage of the change. Is the thinning already being monitored from these points of view?
- In a few places I have seen radical thinning resulting in the toppling over of big Shidekobushi plants, which is not very surprising as their preference for wet soils most certainly goes together with quite shallow root systems.

Additional reading

Some relevant information about pollination and conservation aspects of these magnolias was recently published.

Hirayama K, Ishida K, Setsuko S, Tomaru N (2007) "Reduced seed production, inbreeding, and pollen shortage in a small population of a threatened tree, *Magnolia stellata*." Biological Conservation **136**, 315-323.

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References

To save space, detailed maps are not attached. I recommend further information from the reference often mentioned as JASC, see below.

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