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It’s time to plan for the
IWGS 2009
Chicago, IL, USA Symposium
July 15–19, 2009
Post Symposium to follow

Host site and hotel is the Pheasant Run Hotel
www.pheasantrun.com
St. Charles, IL, USA
Recently proclaimed the “Water Garden Capital of the World”

Possible tour options include the Chicago Botanic Gardens, Ball Seed Trial Gardens, Morton Arboretum, Field Museum, Shedd Aquarium, and a number of the USA’s top 100 garden centers.

Visit www.iwgs.org for more information as it becomes available about this great opportunity.

Contact person for our 2009 Symposium is
Jim Wullschleger, OJCW@aol.com

IWGS Website
Members Only Page

The members page features exclusive society news, articles and online voting. The member log on is symposium and the password is virginia. Members will be notified by email whenever this password changes. After logging in, the members only page allows you to select the current Journal and it will download in a PDF format for viewing. This Journal issue is available online in color for viewing, printing or saving.

www.iwgs.org
What a difference a few months or even a year makes. What is on the minds of so many of us from around the world? The economy is what we think of first. No matter where you are, the economic situation is probably something you have had to consider. Whether you are a retailer, a grower, or a homeowner, our global economy is no doubt something affecting you.

We mention this not only because it’s hard to ignore, but to ask for you to relate your experiences or solutions to others in our association. So, we’re appealing again for readership input. Not everyone likes to write, but we assure you, your thoughts are important and interesting to someone else.

Our society is gearing up for another year, making plans for the next waterlily competition at the Sarah P. Duke Gardens in Durham, NC. If you have a new waterlily to enter, get in touch right away with Mike Swize at mike@nelsonwatergardens.com or John Loggins at dowork@verizon.net.

Beginning with the next Journal issue, Charles Thomas will start a four part series on the IWGS History, for our 25th anniversary in 2009. Anyone having interesting photos, thoughts or stories should email them to Charles at charlesbthomas@comcast.net. We’d love to hear from everyone about their most memorable, exciting or funny experiences.

Last quarter we launched another member benefit, the Let’s Talk Water Gardening Yahoogroup. This online discussion group had some bumps getting started, but was interesting to read. Please post a thought or question to start a conversation with our membership, at letstalkwatergardening@yahoo-groups.com.

Coming soon will be an itinerary for our 2009 Symposium to be held in St. Charles, near Chicago, IL, USA. We will join with Aquascapes, Inc., this years’ host, for tours, education and fun. Please try to attend and get to know members of our society. Just as important, this is a chance to meet new faces from our host company. This will be an opportunity to encourage them to join our society and a way for them to tap into our aquatic plant knowledge. We hope to help them learn from us while we have much to learn from their extensive pond building experience.

Besides the regular program there will be two auctions. Each year one auction raises money for us by selling the neat items you bring. Start thinking about something unique to bring, something small enough to be carried home on a plane or by car. In the past, we have had small fountains, antique dishes, rare waterlilies, beautiful artwork and so on. You would be amazed at what some attendees come up with.

The Symposium also features an auction to raise money for our Scholarship and Research Fund. These items are donated by our friends in manufacturing and wholesale suppliers of pond care products. There may be case quantities of products, dip nets, and all sorts of water garden items. The funds raised have gone to study a couple of things that are discussed in this Journal issue—edible lotus and waterlilies in Russia, Siberia and the Far East.

Please join us in July. You’ll have fun and learn a lot. The American Midwest is beautiful; you’ll find plenty to see and do.

As always, we look forward to hearing from you about anything at all. We hope some of you will put together an article for your fellow will put together an article for your fellow water gardeners to read in future journals. Have a great year!
Call For Nominations For The IWGS Board Of Directors

Criteria for Nominees

The candidate must be an IWGS member (for a minimum of two years) and be able to serve a full three-year term, as well as be willing and able to participate in all Board discussions, voting and meetings throughout the year. The Annual Board Meeting takes place at the Symposium – all other meetings are online or by phone.

Candidates also should:

• Understand and be dedicated to the IWGS’ ideals, mission, and objectives
• Possess a notable reputation in their profession or area of endeavor
• Have the expertise and competence to make sound decisions for the IWGS
• Demonstrate a readiness to make a significant commitment of time and to make available or have access to resources – human, financial, and material – on behalf of the IWGS during tenure on the Board
• Be willing to represent membership’s interests and concerns in Board deliberations
• Enhance the diversity of perspectives represented on the Board
• Be persons whose presence contributes to a strong, working Board
• Have a record of service to and financial support for the IWGS
• Make every attempt to attend Symposia during their term of office
• Be willing to serve as volunteers, without compensation other than the reimbursement of certain expenses
• Be able to work and communicate in written and spoken English
• Be accomplished persons of integrity, objectivity, and intelligence, with reputations for sound judgment and open minds, and a demonstrated capacity for thoughtful group decision-making

The Nominations Committee encourages nominations at any time, as they are building a pool of candidates for the future.

Nominations should contain the following information and be e-mailed to Rowena Burns at wtrgdn@eagle.ca or Tom Tilley at tom@tilleysinc.com

NOMINEE:
Full name of the Nominee, email address, and phone number
List of the qualifications of the Nominee
Full name of the Nominator, email address and phone number.
Deadline for nominations February 16, 2009
EHV (CyHV-3) and the Case for Biosecurity in the Koi and Carp Industries

by D. Benjamin, Managing Director
Hazorea Aquatics – Kibbutz Hazorea, Israel

Abstract

Koi Herpes Virus (KHV), under certain environmental conditions, results in heavy mortalities of populations of koi and carp (Cyprinus carpio). Koi are traded on a continuous basis in the worldwide ornamental fish market and the common carp is an important protein source, especially in many developing countries. During the last decade KHV has spread rapidly throughout the world and has resulted in significant economic losses to the carp and ornamental fish industries in some countries. KHV outbreaks have been documented in Israel since 1998. Production of carp and koi on farms throughout Israel were considerably reduced during the initial surge of disease, with massive fish kills. Three active approaches to the restoration of economic production were implemented by Israeli fish farmers, all claiming to assist in the containment and eradication of KHV.

1. Initially, farms in Israel performed natural immunization (NIS) of the carp and koi as a solution to viable production.
2. A vaccine has recently been developed and is used in some koi and carp producing farms in Israel.
3. Certain farms in Israel destroyed all infected or compromised stock and continue production in indoor or outdoor virus free, biosecure facilities.

This paper will present the case for biosecure production and stocking of virally uncompro-
mised carp on farms and facilities around the world, in the context of a strategy of worldwide eradication and containment of KHV as well as future pathogenic threats.

Introduction

It is estimated that by the end of 2008, about 15% of Israel's koi exports will originate from bio-secure facilities where the fish are never exposed to the virus. The rest will come from facilities that vaccinate their koi. The percentage of virally uncompromised koi exported from Israeli koi suppliers by the end of 2009 is expected to increase to about 40%, as existing facilities are expanded and new ones built.

Most members of the koi and carp industry in Israel, including this author, are aware of and have a high regard for the achievements of those involved in saving and resurrecting the carp industry in Israel, which faced extinction in the early years of the virus. It is important that a safe vaccine for KHV be developed as an integral tool in the effort for global eradication of the virus, and as a protective measure for the continued existence of the trade by helping containment in the event of localized breakdowns in biosecurity.

This paper is not a scientific and/or empirically based manuscript. Much of it is based on the lessons learned from the production of koi and carp in Israel, as well as existing research and documentation on the use of vaccines in animal disease eradication and containment. They show that worldwide containment, eradication and prevention of KHV cannot be carried out using only vaccination, but necessitate the production and distribution of carp that have not been virally compromised. Eradication and prevention of diseases and security against the eventuality of new pathogens are not possible without the encouragement and gradual implementation of biosecurity in all parts of our industry, but especially in production, on a world-wide scale.

Dealing with KHV as a Global Threat

KHV threatens not only the livelihood of a large number of koi producers, dealers and hobbyists. It also threatens the angling community, which in many countries is far larger than the number of koi hobbyists. However, the overriding concern of responsible authorities around the world is the fact that the common carp is the third most important farmed freshwater fish species in the world (FAO World aquaculture production statistics for 2005) and fish are the major protein source of many communities worldwide. FAO statistics on world aquaculture for 2006 show that aquaculture provides about half of the total fish consumption of humanity. Fish provide 2.6 billion people with more than 20% of their total protein diet. The stakes are much higher than an ornamental or angling hobby for the wealthy of our planet.

Measures for the prevention and/or eradication of KHV that are recommended or enforced by authorities must therefore take all the above facts into account. In order for them to be effective and enforceable, measures must lend themselves to methods and means available to carp producers in both developed as well as developing countries. They should not only be easily available to and applicable by farmers, exporters, importers, wholesalers and retailers, but should also be enforceable in practice by local authorities from the UK to China, from Israel to Bangladesh, and from the USA to Vietnam.

At the time of writing there is no evidence indicating that worldwide carp production is directly endangered by KHV. Most of the reported incidences
of KHV have been in the ornamental fish industry—in koi farms, trade facilities or private ponds where containment and prevention of further contamination can be relatively easily achieved. There have also been a few reports of KHV in natural waters in some parts of the world but this has usually only affected the angling community. Almost all the carp produced for human consumption are grown on farms and in aquaculture facilities, few of which, to date, have been affected by KHV. (Israel is one exception to this and the Israeli carp industry was severely damaged by the spread of KHV.) However, steps need to be taken to ensure that the situation regarding this important food source remains unchanged, and that carp farms around the world remain, as far as possible, uncompromised.

The fundamental premise for a worldwide effort in the prevention and control of any disease is the ability to impose restrictions and regulatory measures that are viable and that can be implemented with relative ease and low cost around the globe. In the case of the carp, this includes food carp producers as well as growers, importers, distributors, retailers and consumers in the ornamental trade. These measures should be applicable and feasible not only in countries or areas like the USA, the EU and Israel but also in developing countries with lower standards of living, meager national budgets and very different national priorities.

A Few Facts About KHV

1. To date, at least three known strains of KHV exist, each with differing symptoms and differing rates and percentages of mortality. The number of variants is most likely much higher (Takashi, 2007).
2. KHV is highly contagious and can result in high (over 80%) mortality in diseased populations of koi and common carp (Dishon, 2005).
3. Neither the "immunisation" process nor the present vaccine that is used in Israel has categorically been proven to be effective for all three strains of KHV.
4. There is to date no definitive test that proves whether a fish is an active carrier of KHV.
5. The virus can remain persistent and dormant in the organs of the host, without any expression of viral pathology for long periods of time (Dishon, 2005).
6. Survivors of KHV are potential carriers of KHV (St-Hilaire et. al, 2005).
7. Recent research has shown the presence of asymptomatic KHV in goldfish and other aquatic species, leading to conjecture that these may also be hosts and/or carriers of KHV (Sadler et. al, 2008; El-Matbouli et. al, 2007; Meyer, 2007).

Past and Present Use of Vaccines in Disease Eradication

Vaccination is without doubt the single most useful measure available to prevent infectious diseases, and numerous examples of successful vaccines exist. However, in every single case there were other extremely important factors which contributed to this success. The most successful case of virus eradication in history is that of the smallpox virus. This campaign was effective because the variola virus (i) produced acute illness in humans, (ii) had no carrier stage or unmanageable non-human reservoirs, and (iii) sensitive and specific tools were available for diagnosis and surveillance. In addition, an effective vaccine was available and could be used in combination with political commitment, international surveillance and public education. (Nelson, 1999)

There seems to be apparently increasing disagreement in medical and scientific circles regarding the negative, long-term side effects of vaccines and their ability to completely eradicate a pathogen. Notwithstanding this controversy, the principle generally accepted is that the use of a vaccine is not the only ingredient for disease eradication. The contrary is true; while it reduces the prevalence/incidence of outbreaks, a vaccine usually guarantees the persistence of the pathogen and its associated disease. In almost every scenario of disease prevention or eradication, a vaccine is only one of a number of measures put in place. Other measures usually include sanitation and, in the case of animal diseases, stamping out. (Killing off all infected or potentially infected animals). Often, the vaccine is only a part of an eradication pro-
gram as in the case of Bovine Tuberculosis. (House of Commons, 2004) In some cases a vaccine could hinder eradication programs, as in the case of Hog Cholera Virus (Institute of Medicine, 2002).

A survey of literature available on the subject shows that for most animal diseases, programs are implemented combining stamping out, biosecurity and restriction of movement. In some of these programs, for example Brucellosis, where the vaccine allowed tracking of infection among vaccinated animals, vaccination was permitted in specific areas and for a defined period of time. (W.H.O. website www. who.int/zoonoses/diseases/brucellosis/en/). In other instances for example, FMD or Bovine Tuberculosis, the use of a vaccine was prohibited or partly prohibited. In cases where the use of certain vaccines is allowed for a limited time the reason is usually an economic one. Although it is clear that the vaccine contributes little to the eradication of the disease, it is sometimes unreasonable to enforce stamping out (killing off all animals suspected of infection) and thus bring financial ruin upon the farmers involved.

The rationale for disallowing the long-term use of veterinary vaccines is based on the fact that, besides the compromised of diagnostic tools (for example in Bovine Tuberculosis), vaccination is employed on a vast number of individuals (tens of millions in the case of fish). In every case of mass vaccination there are always individuals that are “low responders” or “vaccine escapers” and these create reservoirs for the persistence of the disease. What matters is not the large numbers of immunized individuals, but the potential danger of small numbers of non-immune individuals that persist in the vaccinated stock. For herpetic diseases, or where a carrier state is known to exist, the likelihood of viral persistence among vaccinated stock is much higher. Since it is impossible to round up and vaccinate all the fish existing in natural waters, these potential carriers may come into contact with and infect naive populations of fish in nature, thus spreading the virus even further.

In summary, vaccination is of limited use as a measure of control or eradication for any infectious disease if the following factors exist:

1. There is a high transmission rate of disease between susceptible hosts.
2. The vaccine efficacy is less than 100 percent.
3. Occult disease is manifest and transmitted subclinically before diagnosis.
4. A low frequency and low level of challenge exists against susceptible pools in given geographical regions.

Points 1 to 3 above are definitely true for KHV and these characteristics have been cited in almost every scientific paper published on the disease (Haimi, 2003).

Regarding the frequency (point 4), statistics on the number of outbreaks exist in almost every koi producing country and in some carp producing countries. Before debating whether these comprise high or low incidences, whether many incidences go unreported, or whether KHV exists everywhere or not, a number of facts should be considered:

1. Most of the outbreaks are on ornamental farms, trade facilities or private ponds where containment and sterilization can be carried out relatively easily.
2. Outbreaks in natural waters cannot be controlled, either by vaccine or any other method, because of the fact that 100% of the fish cannot be vaccinated and because the disease is occult and transmission cannot be prevented.
3. In light of the fact that the common carp is the third most commonly farmed food fish in the world, even limited incidences of KHV could cause food shortages and economic damage to producing countries. This is obviously not the case at the present time. The conclusion can therefore be made that the level of challenge for KHV is low and does not warrant a solution involving vaccination except in cases (similar to that of the countrywide KHV outbreak in Israel between 1998 and 2001) where infection has reached levels where containment and stamping out may not be viable or economical.

Due to the unique structure of the aquaculture industry (millions of fish, shared water, worldwide trade), there is a natural hesitation to establish eradication programs. However, recent history tells us that these fears can be overcome if a decisive, coordinated and well-structured pro-
gram is implemented. This is demonstrated by the success of the European Union policy for the eradication of VHS. Any such program will inevitably be based on measures of basic biosecurity that are required to be put in place at all points in the supply chain.

Firsthand Testimony Demonstrating the Value of Biosecurity in KHV Eradication

Following the KHV outbreak in Israel in 1998, the Hazorea koi farm was the last commercial koi farm in Israel to be infected (in the spring of 2000). The production of koi in open air ponds at the Hazorea farm was immediately discontinued. Production continued in an indoor biosecure pilot facility which was enlarged and intensified. Since 2001 Hazorea has been producing koi in intensive indoor biosecure facilities. The outdoor ponds are now used exclusively for the production of goldfish. Periodic challenges by KHV are made by the controlled introduction of uncompromised naive koi into various outdoor ponds for extended periods of time during the time of the season when water temperatures are most suitable for KHV infection. Since 2001 KHV has never been found at the Hazorea farm and the disease seems to have disappeared completely. A safe, KHV free environment was achieved in one season without the use of natural immunisation or vaccination.

The case study detailed here shows that it could be relatively simple to achieve a basic biosecure status on any koi or carp farm in the world. In some cases a coordinated effort is required for farms adjoining each other or when water sources could be compromised by run-offs from other farms.

Looking Beyond KHV

The past decade has seen a marked increase in the aquaculture industry around the world. From statistics published by the FAO in 2004 it is clear that aquaculture is by far the fastest growing sector of world food production. Fish are the most rapidly increasing commodity produced and/or traded globally and among commodities, accounting for the largest export earnings of the developing countries. In fact fish exports from developing countries earn more for these countries than all the other commodities put together! The ornamental fish industry is seeing a similar trend of movement from traditional open water “natural” farming to intensive controlled farming with the increased use of regulated and enhanced breeding programs using limited genetic pools. Increased intensification results in an increased risk of infectious disease outbreaks, and crowding increases the vulnerability of a population of animals to disease and death from opportunistic and obligate pathogens (Bebak, 1998).

The combined result of this orientation is the increased risk of disease, and of the emergence of new and as yet unknown pathogens. The new pathogen may be far more deadly and have dangerous, far-reaching implications on the future of this industry which has become so important to the lives of millions of people around the world. Vaccination usually provides an induced immunity that hopes to prevent recurring infections of a specific pathogen. Rather than waiting for new pathogens to appear, and then spending 5 or 10 or 20 years and thousands of dollars developing another vaccine, we should act now to safeguard ourselves and the future of our food sources. Rather than waiting for new pathogens to spread to our rivers and lakes to organize a worldwide scientific effort to find applicable solutions, an approach is needed whereby we start today to put in place the systems that will help us protect ourselves tomorrow from what is an almost certain eventualty. KHV is a sample of what may be in store for us around the corner. Our reaction needs to be one that helps us in the containment and eradication of KHV, while reinforcing our defenses against dangerous new pathogens.

Biosecurity–The Solution for the Present and for the Future

Medication and vaccination have traditionally played a major role in treating diseases but it is now widely accepted that they cannot, in isolation, prevent losses due to disease. Modern farming demands a holistic approach. Unless the background
The challenge from disease causing organisms can be controlled, and good management practices strictly followed, medication and vaccination alone are not capable of adequately protecting fish stocks. Fish must be given an environment in which the level of infection is controlled to the point where vaccination and medication can achieve beneficial effects. Biosecurity is the key to achieving this (Aquaculture Biosecurity Program).

Biosecurity consists of practices and procedures that:

- reduce the risk that pathogens will be introduced to a facility
- reduce the risk that pathogens will spread throughout the facility
- reduce conditions that can increase susceptibility to infection and disease (Bebak-Williams et. al., 2006)

As aquaculture systems become more and more intensive the biosecurity measures put in place need to be more rigid and detailed. However, in a traditional open-air, mud-pond fish farm, there are certain basic measures that can be practiced with relative ease by any fish farmer in any part of the world and although these may have limited efficacy, they can be intensified and expanded as and when needed or according to the level of safeguards required. One of the greatest impediments to achieving a safer, more biosecure environment is the “all or nothing” attitude based on the argument that it is not possible to achieve complete biosecurity in many facilities and especially in outdoor farms. This is like saying that there is no point in locking our houses as it is impossible to make them completely burglar proof. With biosecurity, every step we take to make our premises, our stocks and our production safer, is a step in the right direction. Put schematically, the key to achieving biosecurity is the way we think, behave and work. “Thinking Biosecurity” means being constantly conscious of what we are doing and with whom and with what we are interacting. “Behaving Biosecurely” means acting responsibly in a way that ensures the biosecure environment and reacting immediately to actual or potential threats. “Working Biosecurely” means putting in place and using procedures that

ensure biosecurity in every aspect of our work—from our clothes and our equipment to our daily routines. Basic biosecurity is as much a state of mind and behavior as keeping our children safe and healthy. It is a concept that anyone, anywhere can appreciate, learn and emulate.

The importance of biosecurity in an ever-shrinking world where diseases have no borders and new strains or mutations of pathogens are being discovered regularly cannot be emphasized enough.

**Basic Biosecurity**

It is not the intention of this author to provide more than an overview of basic biosecurity that can be easily implemented in almost any production facility or farm anywhere in the world. Extensive and comprehensive literature on the subject has been published by many, and special mention should be given to material published by OATA (Aquaculture Biosecurity Program, 2006). Basic measures are usually implemented by treating, controlling and monitoring the following elements in ways that reduce the risk of infection and the risk of the introduction and/or spread of pathogens:

- Incoming and outgoing water
- Eggs, fry, new fish or broodstock brought in from other locations.
- Fish feed
- Equipment used
- Movement of staff and visitors and their vehicles
- Protection against wild animals and birds
- Removal of dead fish
- Monitoring and reporting of unusual mortalities
- Sterilization procedures

It is clear that not every farmer in every location can carry out and/or practice a strict regime of biosecurity that includes all of the above factors. However, awareness will always provide better results than ignorance, and achieving partial biosecurity is better than relying solely on medication and luck. The education of fish producers, exporters, wholesalers, and retailers as well as anglers and hobbyists on the basic rules of biosecurity and how to practice them
will do more for disease prevention, eradication and control than the traditional methods of medication and vaccination. This education may prevent the farmer in rural China from losing an entire stock to disease and it may help stop the spread of a dangerous disease from a wholesaler of koi to retailers around the country. If all the links in the chain of supply use simple-to-follow and easy-to-implement rules of biosecurity, a reduction in the danger of the spread of disease will naturally follow.

Summary and Conclusions

1. Producing KHV compromised carp under a regime of either natural immunisation or vaccination is at present no guarantee that the disease will ever be controllable. Historical evidence proves that while vaccination can be an important aid in the eradication of certain diseases, it does not completely stop the carrying and distribution of a virus, especially where numerous strains exist or are liable to mutate. For a vaccine to be deemed effective in a worldwide eradication program there needs to be a rigorous and tested appreciation of its side effects and long-term consequences, as well as an in-depth analysis of its cost efficiency in poor and developing countries, prior to its universal application. Even then a vaccine can, at best, play only a small part in an eradication effort.

2. Vaccination is at best, of limited use in the control of KHV (i) since the disease is highly infectious, (ii) the vaccine does not provide a 100% efficacy, (iii) the disease is transferred sub-clinically by means as yet not fully understood or known and (iv) there is to date a low frequency of occurrences in most geographical regions.

3. It is the belief of the author of this paper that at present the only way to be absolutely sure that a population of carp is KHV free is if it is bred, maintained and transported under biosecure conditions that do not allow cross infection with potential carriers of the virus. The key to maintaining a disease free population of carp is the implementation of easy-to-learn and easy-to-follow pragmatic guidelines for the maintenance of basic biosecurity on production sites of all kinds and in all areas.

4. The control and/or eradication of KHV as a threat can only be achieved by adopting a “back-to-basics” policy of prevention and stamping out, while immunisation by vaccine can and should be carried out in extreme cases as a backup, in a limited and restricted area and then only with a vaccine that has undergone exhaustive testing and proved effective against the relevant strain of KHV.

5. Furthermore, the use of biosecurity as a preventative measure provides a solution not only for the present KHV problem but prepares us for the predicted eventuality of developing pathogens that will undoubtedly appear as aquaculture becomes more and more intensive. More importantly, by introducing the concepts of biosecurity on a production level whether on a carp farm in rural China, or on a highly intensive recirculating aquaculture system (RAS) facility in the USA, we are sowing the seeds that will grow to help protect our planet from poverty, disease and food shortage. It would be fitting to sum up this view of biosecurity with the three truisms so aptly stated in the booklet produced by OATA (Aquaculture Biosecurity Program, 2006).

• If a pathogen isn’t present on a site it can’t cause a disease on that site.

• If a pathogen isn’t present on a site it can’t be transmitted from that site.

• If the pathogen is present at a supplier’s site then better it remains there. Curative treatment to eradicate the pathogen prior to fish leaving that site may be required.

KHV (as well as other equally dangerous fish pathogens) should serve as a wake-up call for the aquaculture fraternity. The responsibility for all those involved, farmers, scientists and policymakers, goes beyond this specific virus and has applications to developing diseases and the way we deal with them as a global community.

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Storing Tropical Nymphaea Tubers

Winterizing doesn’t always have to mean not growing tropical Nymphaea tubers.

I know that a million gallons of ink has already been spilled on this issue, but the questions persist so I will address them here. As with any pursuit, there are conflicting schools of thought concerning the things that are necessary for success. There are many variables involved in whether a plant tuber will survive dormancy, and the challenge of any grower is to reduce those variables in both number and severity. I have tried a few methods, and have both failed and succeeded with each of them.

We have all seen tubers survive in unplanned situations and wondered what factors went into their survival, especially since we have seen tubers in similar situations die. In any sort of husbandry, learning what happens to an organism in its natural habitat will give clues to how we should treat it in our collections. In the case of tropical Nymphaea, dormancy is brought on by drought, not cold, as is true with hardy Nymphaea.

In most tropical climates there are two seasons, wet and dry, both warm. When it is wet Nymphaea grow, blooming and making seeds as fast as possible. But when the water recedes the plants are presented with a problem. Obviously, they have the capacity to adjust, and they do so by absorbing their leaves and roots to produce resting tubers. Resting tubers remain viable for years if the ground does not remain too dry for too long. Occasional rain keeps the tubers damp enough to stay alive but not wet enough to grow, and if they are fortunate enough to not be eaten by a tuber-eating animal, they can survive to the next flood season.

We can mimic this cycle by removing our potted plants from the pond before they are forced into dormancy by cold, which frequently kills the plant. I allow plants to progress until they have lost most of their large leaves and have begun to make smaller leaves. This occurs in October and November (in Southern California). Once I have removed the plant from the pond I can choose between making it grow in reduced conditions, or forcing it into complete dormancy. In the first instance, which I prefer, I allow the plant to remain in its pot in the greenhouse, in shallow water, until it is reduced to the point where it can be broken down and crammed into a small pot. The plant will continue to grow in the small pot, in unfertilized soil, and in extremely shallow water. Because it is easier for the plant to reproduce by division of its tuber than by producing flowers and seeds, they can be forced to produce numerous tubers over a two or three year period in stressful conditions. Each of these tubers can be separated and grown separately.

If I decide to store the tuber, I set the pot on the floor of my greenhouse, wrapped in a plastic bag, and allow the plant to absorb all of its leaves. This usually leaves a nice tuber, or tubers, in the pot which can be exhumed and cleaned. If the plant has been in the same pot for more than one season there is a good chance that there will be more than one tuber. Sometimes the primary tuber will have died, but you will frequently find smaller ones around the base of the parent.

The most popular storage media are peat moss and sand. I prefer peat. It is lighter and I just seem to do better with it. Whichever you use, it and the water that dampens it, should be clean and you must inspect the tubers periodically to ensure that they remain properly damp. I dampen the peat until it is obviously damp but is still crumbly. I use enough to keep the tubers separated. Each tuber is washed and placed apart from its counterparts. I use zip lock bags instead of glass jars, and I keep the bags within other bags to retain moisture. The tubers stay under a bench in my greenhouse until spring. I have also stored them under my bed and in my garage. During the winter, I will check them two or three times for fungus and dryness. Dead tubers are discarded and all are washed.

Whichever method you use, potential profit can be gleaned from the plants generated. It certainly beats having to buy plants to sell each year.

dc@pondplants.com
Everyone has heard the word “Lotus.” Beyond our relatively small society, some people recognize lotus as a computer program, a car, soap, water, a band and other products that have capitalized on the true original lotus. Most people recognize lotus as a very important Asian flower, an icon in many countries which has become an integral part of the cultures of many people. It is a beautiful flower that has been raised to the level of a religious symbol. We saw the importance of these flowers to the Chinese culture during the Olympics. They were displayed throughout the Olympic village and used as a symbolic part of all the pageantry.

Lotus is a water plant. It grows in shallow, still water in natural areas that many people do not see very often and if they did, they probably did not recognize the flower. Many people would recognize the seed head used in dried flower arrangements but probably could not name the plant from which it came or that it grew in the USA. In other countries, lotus is part of their culture (Orozco-Obando, 2007) and introduced in the classroom as part of history or health and science classes. There are social and religious festivals dedicated to celebrating the annual flowering and harvest of lotus. Like cotton, corn, peanuts, tobacco, apples, peaches, watermelon and other annual agronomic and horticultural crops are honored in celebrations in the United States, lotus is raised to a similar status around the world. Did you know that a few billion people eat lotus as part of their daily diet? They eat lotus like we eat potatoes and rice. How did the people in the USA miss a food that is enjoyed by so many around the world? Even our own Native Americans ate lotus as part of their diet. It is one of nature’s most wonderful and diverse plants. It deserves some sampling time and exposure in the United States to explore what others have been enjoying for centuries.

The term “edible lotus,” which seems to be a foreign classification for those in the Western hemisphere, is well defined for Asian cultures. According to Romanowski (2007), virtually all parts of both American and Asian lotus species and all hybrids are edible. Lotus is a relatively primitive plant and belongs to its own family—Nelumboneaceae, and genus Nelumbo. There are only two species in this genus: *N. lutea* and *N. nucifera*.

**The American Lotus – *Nelumbo lutea***

The American species *N. lutea* is known as American lotus, water-chinquapin, and yellow lotus (Sayre, 1963). This species can be found growing in 32 states (USDA, 2008), in the extreme southeastern portion of Ontario, Canada, and native stands have been reported throughout the West Indian Archipelago and into northern South America (Quichao and Xingyan, 2004). So, lotus is not just an Asian plant. We have been living in the middle of it our whole lives. How could we not
know about this incredible plant loved by so many people around the world? Unless you were taught that all parts of the lotus plant were edible, you would not think to dig up the underground runners. Although our potatoes, carrots, peanuts and other edible plants come out of the ground, we probably would not feel comfortable digging a rhizome (underground stem) out of the mud, cleaning it and putting it in a salad. It is fortunate that someone in ancient history was not too squeamish to give it a try. The peoples of China, India and other Asian countries continued to enjoy the delicacy while it got lost and was not transferred from the culture of our American Indians.

The Edible Water Chinquapin or Yellow Lotus

In the Americas, the few reports on the use of the American lotus as a source of food are limited natural history accounts of Native American diets (Harrington, 1978). Sayre (1963) reported that a number of American Indian tribes (Comanche, Dakota, Huron, Meskwaki, Ojibwa, Omaha and Potawatomi) used various parts of the plant as a source of supplemental food. Most of these reports do not specify particular varieties/cultivars and it is assumed that those references refer to wild plants. All the parts of the plant (tubers, shoots, and leaves) were cooked and eaten as a vegetable. The large tuberous roots (the diameter of a human arm) used to be baked and it is described as rich in starch. When baked it becomes sweet and mealy, somewhat similar to a sweet potato. The root is usually steeped in water prior to cooking in order to remove any bitterness. The unrolling young leaves can be prepared like spinach (Peterson, 1978). Other reports deal with local uses of the species. For instance, Hernández et al. (1991) reported the use of our native lotus in Tamaulipas, Mexico as a source of edible seeds and roots. In southern Louisiana USA, lotus seeds are called “Graine à voler” in the Cajun French dialect. A culinary delight in some areas, lutea seeds are described as a soft-textured snack reminiscent of a peanut (Lundin, 2008). Native Americans used to gather the hard seeds, added to soups or roasted. Seeds can also be dried and ground into flour for making bread.

The Sacred Lotus—*Nelumbo nucifera*

This species is the Asian counterpart to our American lotus and is known as: lotus, Indian lotus, Asian lotus, lotus root (rhizome), East Indian lotus, Chinese lotus, Egyptian lotus, Lian, Lingnau (China, Taiwan), Hasu (Japan), Bhain (Pakistan), Renkon (edible rhizome in Japan), Bong sung ma (Vietnam) and Padma (Bangladesh). The plant has an East Indian origin with introduction to China and Egypt thousands of years ago. The Chinese introduced lotus to Japan where it has been studied and cultivated for more than 1,000 years (Masuda et al. 2006). Today, the plant has also been reported in the northern part of the Soviet Union and in the Volga River delta (Slocum and Robinson, 1996; Quichao and Xingyan, 2004; Xueming, 1987, Yamaguchi, 1990). Commonly called the edible lotus, *Nelumbo nucifera* rhizomes are grown, cooked, and used like potatoes, and are considered a staple in some Asiatic countries (Billing and Biles, 2007). In Taiwan, for instance, a very compact, thick-rhizomed variant of *nucifera* is a dietary staple and the plant is planted extensively as a food crop (Slocum and Robinson, 1996). In Australia, aboriginals use the seeds and roots of this plant as a part of their diet (Considine, 1996).
Eating Renkon

The tubers make a great addition to stir fries when peeled and sliced, remaining firm even when cooked or canned (Romanowski, 2007). The crisp tubers are also sliced to reveal their beautiful, intricate, lacy patterns, then baked to make a candy of sorts, boiled in soups, or fried for chips. They can be frozen and used as an ingredient in pre-cooked foods as a thickening powder (Kew, 2006). The roots are also used in curry, soups, or pickled in vinegar (Inden et al. 1997). Lotus ranks very high among other foods as a nutritious crop. Edible roots contain abundant amounts of starch, sugars, proteins, lipids, vitamins and minerals and, they are considered very digestible and nutritious for all ages (Xueming, 1987).

World Production and Harvest of Edible Lotus

Lotus tubers can be harvested and eaten any time after the plant goes dormant (Romanowski, 2007). However, normally after the first few frosts in the fall, immature lotus roots are crispy and sweet and are favored as summer delicacies (Xueming, 1987). In Wuhan, China, lotus is planted twice a year and the summer crop is harvested when the plant is still actively growing (Orozco-Obando, personal communication). For the “lotus with green leaf” (as it is called in China), the rhizome, which is not yet mature, yield is low but demand and price are very high (Qingdong, 2001). Edible lotus can be harvested after 120 days in warm climates and after 150-180 days or after the leaves die in cold climates (Yamaguchi, 1990). Yield per ha/ac depends on the cultivar and area of production. Yamaguchi (1990) reported yields of approximately 4 metric tons per ha (1.6 t/ac). In Australia, depending on the variety, location, and cultivation practices, yields from 8-12 t/ha (3.2–4.8 t/ac) to 10 to 40 tons/ha (4-16 t/ac) have been reported (Nguyen, 2001; Nguyen and Hicks, 2004). Chinese average productions are 22.5 t/ha [9 t/ac] and the South Koreans reach productions of 31.8 t/ha [12.7 t/ac] (Nguyen, 2001). Rhizomes can reach 60 to 120 cm in length and 6 to 9 cm in diameter. They have a cream, light brown or buff colored skin. For the Japanese market, quality rhizomes must have a milky white color, flesh with high water, and a soft and crunchy texture (Nguyen, 1999).

Seeds, Flowers, Stems, and Leaves—Could We Eat Them?

The acorn-like seeds are considered an oriental delicacy. These are eaten raw, boiled, pickled, candied or ground as meal. In India, seeds are roasted and used as a coffee substitute or puffed like popcorn (Plant for a Future, 2000). The sweet flavor of young seeds is described as a cross between sweet corn and young peas. Meanwhile, the more mature ones have a much nuttier flavor similar to a
chestnut (Billing and Biles, 2007). Seeds can be dried and eaten like sunflower seeds or, pickled in traditional Japanese fashion (Harrington, 1978). Since various parts of lotus can be processed as food (Srihakulang and Buatama, 2008), we feel that will be worthwhile to explore in a further article. However, it is important to point out that deep fried petals are considered a delicacy. The young runners—stolons, stems and leafs are used as vegetables and prepared in multiple forms.

For now, it is important that we “Americanize” the taste of lotus with the help of our taste kitchens. It is also important to reduce the high physical labor requirements of harvesting the crop. Other countries have the benefit or problem of an excess supply of inexpensive labor. Finally, an objective of Auburn University Lotus Project’s research is to be proactive in the development of this crop by starting with production practices which are sustainable and environmentally responsible (Orozco-Obando et al., 2007). With centuries of satiated, happy customers and thousands of sound research papers proving and extolling the nutritional benefits of lotus, it is certainly worth resurrecting our native lotus as well as sampling Asian lotus. Hundreds of years of development of Asian lotus have brought out the best in this amazing plant. At Auburn University we are looking at putting much effort in to evaluating our own native species and determining the qualities it offers that may contribute to further enhancement of this food, floral, environmentally friendly (Orozco-Obando et al. 2008) and medicinal crop. The secret of our own backyard lotus known by the rest of the world is now out and ready for exploration and re-introduction into the U.S. Bon appetite. Lotus is what’s for supper!

References


Neglected Aquatics

by Rowena Burns

Water Strawberry—Potentilla palustris

Variously known as Water Strawberry, Marsh Cinquefoil, Purple Marshlocks, or Marsh Fire-finger, this unassuming native plant brings a unique magic to the water garden. The small 1 inch (3cm) flowers resemble strawberry flowers or single rose blooms, which is logical since the Water Strawberry is a member of the Rosaceae family. Botanically, it is known as Potentilla palustris, syn. Comarum palustre.

Native to wide areas of North America and Eurasia, Water Strawberry can be found from the Arctic Circle to Northern California, USA, and from Ireland to Japan. Look along slow moving streams or pond edges for this bushy little plant. It is hardy from Zones 3-9, however, in many areas is becoming much harder or even rare to find in the wild. Fortunately, it is easy to cultivate, not being very particular about soil type, sun or shade, and will grow in very wet soil or underwater to 3-6 in (7.5-15 cm). It will readily bloom in garden ponds, bursting forth with many little dark red/purple flowers in June, and continue to produce flowers for several weeks. Even the fruits are of interest, looking like tiny strawberries. The older stems are usually bright red, which forms a great combination with the light green leaves and burgundy flowers and fruits.

Water Strawberry combines well with the much more common vertical plants in the water garden, since it spreads horizontally, and reaches up to a maximum height of 18 in (46 cm). It is not usually densely covered in leaves, but a well-grown specimen can be attractively bushy. The older stems are woody, with little rootlets reaching down, as the plant grows progressively longer. Potentilla palustris is known as a colonizer in nature: it stretches out from the shore into the water, and the multiple branching stems tend to catch soil and debris. Over time, the bank of the pond gets filled in and the Water Strawberry stretches out further into the water. This is one way nature stabilizes the banks of ponds and streams, and gradually claims the water back to land.

The leaves of the Marsh Cinquefoil are characteristic in that they are palmate—dividing into five oblong leaflets with toothed edges. There are other terrestrial Potentilla species that have similar leaves, but this is the only one with the distinctive burgundy flowers. There are named cultivars available, including one called ‘Alba’, but usually it is the species Potentilla palustris that is available for sale from water garden specialists.

Leaves of the Water Strawberry have been collected for centuries throughout northern regions to dry for tea. The Haida Indians used the stem as part of a remedy for tuberculosis, and the bitter roots were used for stomach cramps and dysentery. The bees also appreciate the flowers as a great source for nectar. I wonder what Water Strawberry honey would taste like?

Since Water Strawberry is easily propagated from seed or stem cuttings, it deserves more recognition in the water garden as a great under-story plant. Enjoy the charm of the multiple star-like red blooms bursting forth in your own pond.

For some great photos try www.plant-identification.co.uk/skye/rosaceae/potentilla-palustris.htm.

wtrgdn@eagle.ca
Morphological Variability of *Nymphaea Tetragona* in Russia, Siberia, and the Far East

by Polina A. Volkova, Moscow State University, Russia

Editor’s Note. This is a scientific report that resulted from a Research Grant provided by the IWGS. An auction of donated items from IWGS members and businesses is held at each annual Symposium. The funds from this auction provide grants for applied research. For 2009 we have $2,270 available for research grants.

For more information on the Research Grant program or to apply for 2009 grants, contact Barre Hellquist at bhellqui@mcla.mass.ed.

“Response to the Harsh Climate in White Waterlilies: Morphological Variability along the Yenisei River, Siberia”

Introduction

The genus *Nymphaea* (Nymphaeaceae) is the most diverse genus of the aquatic order Nymphaeales. Representatives of this genus are widely used in gardens as decorative plants. Thoughtful knowledge of taxonomy and interspecific variation is needed for the optimal maintaining of ornamentals. However, the Eurasian white waterlilies, subgen. *Nymphaea*, possess a high level of interspecific polymorphism with a poorly investigated nature (Komarov 1970; Heslop-Harrison 1955). Intensive interspecific hybridization in this group was also suggested by many authors, e.g. (Heslop-Harrison, 1955, Uotilla, 2000, and Volkova & Shipunov, 2008), while vast areas of the Russian Siberia and Far East, where *N. tetragona* dominates, still remain almost unstudied. At the same time interesting morphological forms are expected to the East of the Urals. An example is “*Nymphaea wenzelii* Maack” from the Amur region, that was assumed to be any of the following:

1. either a separate species
2. a subspecies of *N. tetragona*
3. a subspecies of *N. candida*
4. a *Nymphaea × Nuphar* intergeneric hybrid (Komarov, 1970). This appears to be just a morphological form of *N. tetragona* (Volkova et. al., in preparation).

Investigation of species morphological variability along the extensive South-North gradient is perhaps the most promising way to study the morphological variability of white waterlilies, as it allows studying the plants’ responses to the extreme conditions (i.e. low average annual temperatures and short vegetation season). This information could be of high importance for outdoor cultivation of waterlilies in harsh climates. Many important morphological characters of white waterlilies change or disappear even after very careful pressing in herbaria. That is why it is so important to investigate morphology of white waterlilies on the fresh material directly in the field conditions.

Initially, the large scale sampling of the fresh material along the river Yenisei was proposed by the applicant. However, the available funds granted to the applicant by the IWGS were smaller.
(USD 750) than the requested sum (USD 3,080). Thus the research program was considerably cut: focusing only on one species of white waterlily (i.e. \textit{N. tetragona}) with field sampling performed only in the Buryatia Republic (shore of Lake Baikal). The granted sum covered transportation and accommodation costs of the applicant during her field trip from Moscow to the Buryatia Republic of Russia.

On account of this, the final goal of this research was the investigation of the morphological variability of \textit{N. tetragona} in Russia, Siberia and the Far East. This study was possible because the data on morphological variability of this species in the Northern Urals and Russian Far East are available from the PhD-project of the applicant (Volkova et al., in preparation).

\textbf{Methodology}

Topographically separated groups of white waterlily plants were treated as a population. Distinct groups of leaves and flowers were treated as one plant (recognition of waterlily plants is often damaged by the active branching of the underwater rhizomes and their frequent defragmentation).

We investigated 17 populations of \textit{N. tetragona} from the Northern Urals, Russian Far East (in July-August 2007, data taken from Ph.D. project of P. Volkova) and from Southern Siberia (in July-August 2008, data sampled for the IWGS project). We tried to investigate all the available plants in the population, so 154 plants were measured in total (Suppl. 1). Six qualitative and five quantitative measures of the most important morphological characters (Volkova & Shipunov, 2008) were observed for each plant (Suppl. 2).

\textbf{Results and Discussion}

There were no significant differences in morphology of \textit{N. tetragona} from the two Siberian regions: the Northern Urals and Buryatia Republic (Suppl. 2, 3). The only exception was the shape of main veins of the leaf blade. These veins were bent in the first third of their length in the Northern Urals, while almost half of the Buryatian plants had straight veins, which is not typical for \textit{N. tetragona} (Komarov, 1970).

The Far Eastern plants were significantly larger than the Siberian ones. Moreover, a high proportion of the Far Eastern plants had lanceolate filaments of inner stamens and main veins bent along all their length. These morphological characters are typical for another species, \textit{N. candida} (Komarov, 1970). The described morphological peculiarities of the Far Eastern \textit{N. tetragona} prematurely lets us recognize them as a separate species (“N. wenzelii Maack”, see above).

The observed differences in morphology of the Siberian and the Far Eastern plants of \textit{N. tetragona} can be explained by climate conditions during vegetation season. The Siberian summer is rather dry (precipitation is about 200 mm per summer) and cool (mean air temperature in July is 14-16°C), while summer in the southern Far East is wet (precipitation is about 400 mm per summer) and warm (mean air temperature in July is about 20°C).

Thus, our results show that the morphology of \textit{N. tetragona} is quite variable, depending probably on the climate conditions during vegetation season. The observed morphological plasticity is promising for ornamental purposes.

\textbf{References}


### Supplements

**Supplement 1.** The investigated populations of *Nymphaea tetragona*

<table>
<thead>
<tr>
<th>Pop. No.</th>
<th>Geographic origin (cf. Suppl. 3)</th>
<th>Number of measured plants</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Khanty-Mansijsk region (Northern Urals) – NU</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>711</td>
<td>Lake Aran-Tur</td>
<td>10</td>
</tr>
<tr>
<td>713</td>
<td>River Akh</td>
<td>11</td>
</tr>
<tr>
<td><strong>Buryatia Republic (Southern Siberia) – SS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>201</td>
<td>Lake near road Irkutsk—Ulan-Ude, 905 km</td>
<td>9</td>
</tr>
<tr>
<td>203</td>
<td>Lake near road Irkutsk—Ulan-Ude, 202,5 km</td>
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<tr>
<td>204</td>
<td>Peatbog Leshkovskoe</td>
<td>11</td>
</tr>
<tr>
<td>806</td>
<td>Lake Maloe Dalneozoryorno</td>
<td>9</td>
</tr>
<tr>
<td>807</td>
<td>Lake Bolshoe Dalneozoryorno</td>
<td>10</td>
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<tr>
<td><strong>Russian Far East – FE</strong></td>
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</tr>
<tr>
<td>730</td>
<td>Amur Region, unnamed lake near town K莫名</td>
<td>8</td>
</tr>
<tr>
<td>732</td>
<td>Amur Region, Lake Krivoe</td>
<td>10</td>
</tr>
<tr>
<td>733</td>
<td>Amur Region, Lake Glubokoje</td>
<td>6</td>
</tr>
<tr>
<td>734</td>
<td>Amur Region, Lake Bol’shoje Pereshjechnoe</td>
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<tr>
<td>735</td>
<td>Amur Region, Lake Dolgoe</td>
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<td>Amur Region, Lake Kлoshinkoje</td>
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<tr>
<td>740</td>
<td>Primorski Kraj, Lake Mramornoje</td>
<td>14</td>
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</table>

**Supplement 2.** Morphological variability of *Nymphaea tetragona* in the three investigated regions

<table>
<thead>
<tr>
<th>Morphological characters*</th>
<th>Geographic region (cf. suppl. 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NU</td>
</tr>
<tr>
<td>1. Number of stigma rays</td>
<td>6-10</td>
</tr>
<tr>
<td>2. Length of leaf blade (mm)</td>
<td>38-78</td>
</tr>
<tr>
<td>3. Width of leaf blade (mm)</td>
<td>42-123</td>
</tr>
<tr>
<td>4. Length of outer petal (mm)</td>
<td>11-23</td>
</tr>
<tr>
<td>5. Diameter of the round, formed by outer stamens (mm)</td>
<td>10-18</td>
</tr>
<tr>
<td>6. Shape of flower base</td>
<td>4 (100)</td>
</tr>
<tr>
<td>7. Shape of filaments of inner stamens</td>
<td>3 (100)</td>
</tr>
</tbody>
</table>

* Morphological characters*
8. Shape of main veins

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<tr>
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<td>2</td>
<td>3 (9)</td>
<td>3 (40)</td>
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9. Stigma shape

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<td>3 (81)</td>
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10. Stigma color

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<th>4 (98)</th>
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<td>4 (98)</td>
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<tr>
<td>3</td>
<td>3 (1)</td>
<td>4 (98)</td>
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11. Shape of central appendage of flower

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<th></th>
<th>2 (100)</th>
<th>2 (100)</th>
<th>2 (100)</th>
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</table>

* Quantitative characters (1-5) are represented by range of their values (min – max). Qualitative characters (6-11) are represented by their values and frequency of them (% given in parentheses, total number of the investigated plants in the region was taken as 100%). Values of the qualitative characters are the following: 6: 1 – round, 2 – roundly-quadrangular, 3 – quadrangular, 4 – clearly quadrangular with prominent ribs; 7: 1 – linear, 2 – lanceolate, 3 – ovate; 8: 1 – straight, 2 – bent in the first third of their length, 3 – bent along all the length; 9: 1 – flat, 2 – slightly concave, 3 – strongly concave; 10: 1 – yellow, 2 – pink, 3 – orange, 4 – red; 11: 1 – short hemispherical, 2 – long conical.

Supplement 3. Location of the investigated populations of Nymphaea tetragona
Mission Statement—The International Waterlily & Water Gardening Society (IWGS), is a non-profit organization of multinational membership dedicated to the furtherance of all aspects of water gardens and their associated plants. As an organization we support and promote education, research, and conservation in these areas.

Volume 23, Number 4. The IWGS Water Garden Journal (ISSN 1069-5982) is published quarterly by The International Waterlily and Water Gardening Society (The Society), 340 Old Quarry Lane, P.O. Box 602, Greenville VA 24440, USA. Phone 540-337-9344 Fax: 540-337-0738, Email info@iwgs.org. All rights reserved. © 2008. The Water Garden Journal is indexed in EBSCO’s Garden, Landscape & Horticulture Literature Index.

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