Nynäshamns Naturskola

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FEEDING OUR WINTER BIRDS

Project part-financed by the European Union

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Preface

The Swedish winter can be harsh on plants and animals, especially so when it is very cold and snowy. It is difficult to help plants, insects and mammals through the winter season; but for the 60 out of 240 Swedish bird species that stay for the winter, you can make a difference. Apart from doing a good deed, you will also learn a lot about birds.

Begin by hanging out a bird table, a ball of fat, some fruit, or a traditional oat sheaf to attract some birds. Hopefully, watching the birds feed will spark your interest and encourage you to learn which species visit your feeding spot and what different strategies birds have for finding food. Perhaps you will flip through a bird book, watch a nature programme on TV, visit the library or call a birdwatcher. Without you noticing, the learning process has begun.

To learn even more you can build your own bird feeder. This can be done at home in the kitchen or at school in an ordinary classroom. Building bird feeders with your class is a great way to enhance learning and put bird knowledge in an everyday context. The project will integrate not only technology and biology lessons but also Swedish, maths, art and perhaps even music (recognizing different birds' melodies and rhythms).

Purpose

This instructor's guide is intended to stimulate subject integration. For you as a teacher it offers the option of working with an interesting theme while simultaneously achieving several of the goals stated in the Swedish Curriculum for the Compulsory School System (Lpo-94). This means that you will be able to substitute several chapters of the ordinary course literature for practical exercises. Thus, there is no need to feel stress about finding the time to work with the theme.

For the pupils, the purpose of the exercises is to combine theoretical knowledge with hands-on applications—a method that enhances learning for most pupils. Working with practical and creative tasks also helps pupils develop an emotional relationship to theory. The cause-effect chain is clear*: I am doing this (building a bird feeder) to achieve this (knowledge of birds and their winter conditions).*

Should You Feed Birds During the Winter?

It can be argued that feeding birds during the winter is human interference with the ecosystem and that you should let nature have its way. Although a valid opinion, this argument forgets that human interference has already greatly changed the situation of our winter birds. The lack of biotopes with biological diversity has led to a diminished supply of natural weed seeds. This is an effect of weed control on corn fields and that nowadays we have less grazed farmland. In other cases, there is an even more direct linkage between birds and human activity. The house sparrow used to look through horse dung to find seeds and insects. Since we do not keep as many horses anymore, putting out bird feeders can be seen as a sort of compensation.

Photo: Robert Paepke

It is often said that if you begin feeding birds in the autumn, you must continue throughout the whole winter. Although this is preferable, birds are surprisingly apt at finding food. If one bird table is empty, they will simply continue to the next. During mild winters with little snow they can also find their own food. However, you should not start feeding birds too early in the

autumn. If you do, there is a risk that some migrating birds are tricked into staying too long and perish when the winter cold comes.

There are a few things to keep in mind when feeding birds: Always place the bird feeder close to a tree or bush that can provide protection if a sparrow hawk or the neighbour's cat should come by. Also, do not put out food scraps containing salt, mouldy bread or rotten fruit. If the birds eat salty foods they will need to drink large amounts of water that is not always easily available during the winter. Furthermore, the bird table should be designed so that the birds cannot sit in the food while eating. If they do, bird excrements will mix with the food and the bird table can spread diseases such as salmonella. It is also advisable to place spruce twigs on the ground under the bird feeder. If not, the birds will sit on the ground to feed, once again with the risk of salmonella spreading via bird excrements.

Fun Facts

Of the 240 bird species common to Sweden, about 180 species (75%) migrate. To a large extent the migrating birds are insect eaters. However, not all insect eaters migrate. For instance, roughly half of the Swedish goldcrests stay for the winter. This little bird (it weighs only 5 g, the equivalent of an A4-sized paper) will hunt and eat an incredible amount of insects and spiders to survive the cold weather. Each goldcrest will eat 2000 insects (or 15 g, three times its own weight) a day. Of these 15 g of food, 13.5 g will be converted to energy used during the day and 1.5 g will be stored as fat and used to produce heat during the night.

Photo: Robert Paepke

Maths Exercises

How much is three times your own weight?

To help the pupils grasp how much "three times its own weight" is, you can convert all numbers to the equivalent for a human being. Assume that an average person weighs 50 kg. This person would need to eat 150 kg of food every day and gain 15 kg of weight before night falls. You might need to inquire if the pupils know how much food they normally eat per day (2-3 kg). To further illustrate the case, you can let the pupils do a maths exercise at home:

How much is 150 kg of food in hot dogs?

The difficulty of the problem can be varied by providing different amounts of information. Adapt the exercise to suit your pupils.

Solution:

One packet of hot dogs weighs 500 g and contains 10 hot dogs. This means there are 20 hot dogs to a kg. 20 hot dogs / kg * 150 kg = 3000 hot dogs.

How many insects must the goldcrest eat per minute?

This is another great maths exercise to demonstrate the toil of the goldcrest. It can be adapted in the same way as the previous exercise. Be alert to what length of day the pupils assume, any reasonable guess will render a good approximation although the answer might not be exactly the same as below. Let the pupils discuss their respective solutions!

How many insects must the goldcrest eat per minute?

Solution:

A winter day has an average of 8 hours of light. 8 hours * 60 minutes / hour = 480 minutes available for finding food. The goldcrest needs to eat 2 000 insects per day or 2 000 insects / 480 minutes ≈ 4 insects / minute. In other words, the goldcrest has to eat an insect every 15 seconds!

More Fun Facts

In contrast to the goldcrest, most winter birds eat seeds. Some birds, such as the great tit, even change from an insect diet to a seed diet during the winter. Let the pupils discuss the shape of the beak of different birds and how the beak differs depending on if the bird eats insects or seeds. How come some birds can change from an insect to a seed diet and other cannot?

Photo: Robert Paepke

The goldcrest's strategy of building up fat reserves during the day is common to most winter birds. Therefore, it is important to feed the birds fatty seeds and sometimes pure fats such as coconut fat. However, the bird's plumage is just as important as energy rich foods for warmth. During the winter, the plumage becomes downier so that when the bird fluffs up its feathers, a lot of air is caught in the plumage. The insulating effect is the same as that in a down jacket: air is not a very good heat conductor and prevents heat from leaving the body. The same principle applies to wearing several layers of clothing: between each layer, an insulating column of air is created.

What Do Winter Birds Eat?

You can easily increase the diversity of bird species around your bird feeder using different seeds and feed mixes. The list below shows some of Sweden's most common winter birds and what they prefer to eat.

Photo: Erik Edvardsson

Blue Tit

Hempseed, peanuts (in a net bag), tallow, lard, blubber, coconut fat.

Photo: Robert Paepke

Great Tit

Hempseed, sunflower seed, tallow, lard, blubber, coconut fat.

Photo: Robert Paepke

Wood Nuthatch

Sunflower seed, beechnuts, hazelnuts, peanuts (in a net bag).

Photo: Robert Paepke

Greenfinch

Hempseed, sunflower seed, wild bird seed mix, pet bird seed mix, flaxseed.

Photo: Robert Paepke

Bullfinch

Hempseed, sunflower seed.

Photo: Erik Edvardsson

Chaffinch

Hempseed, wild bird seed mix, pet bird seed mix, flaxseed, beechnuts.

Photo: Erik Edvardsson

Marsh Tit

Hempseed.

Photo: Niklas Nilsson

Common Redpoll

Wild bird seed mix, pet bird seed mix, flaxseed, peanuts (in a net bag).

Photo: Erik Edvardsson

Yellowhammer

Oat, pieces of bread, cooked unsalted rice.

Photo: Niklas Nilsson

Eurasian Jay

Beechnuts, hazelnuts, tallow, lard, blubber, coconut fat.

Photo: Robert Paepke

Tree Sparrow

Hempseed, wild bird seed mix, pet bird seed mix, flaxseed.

Photo: Robert Paepke

House Sparrow

Hempseed, oats, pieces of bread, cooked unsalted rice, wild bird seed mix, pet bird seed mix, flaxseed.

Photo: Robert Paepke

Tree-Creeper

Tallow, lard, blubber, coconut fat.

Photo: Robert Paepke

Goldcrest

Tallow, lard, blubber, coconut fat.

Photo: Erik Edvardsson

Great Spotted Woodpecker

Hazelnuts, tallow, lard, blubber, coconut fat.

Studying Winter Birds

Can this...

…become this?

When building a bird feeder, your own imagination is the limit. However, using some basic criteria as a starting point is the key to a good design. The suggestions below can of course be modified, or added to, according to your own or the pupils' ideas.

- The feeder must have a container for seeds.
- Birds should be able to feed easily.
- Birds should not be able to sit in the seeds.
- At least two birds should be able to feed simultaneously.
- It should be possible to hang the bird feeder from a tree.
- The feeder must protect the seeds from snow and rain.
- No parts should be sharp or dangerous.
- The feeder should be good-looking, well crafted, and rain resistant.

Once the feeders are in place, here are some ideas of what to study:

- Which feeder works the best?
- Which species come to the different feeders?
- At what time during the day do the birds feed?
- What foods do the different species prefer?
- Is there any connection between the shape of the beak and the food preferred by a certain species?
- Which species will stay at the table to eat?
- Which species will fly away with the food?
- Which bird species is the most dominant at the bird feeder?

Of course, studying birds can be done using existing bird feeders. However, this means you will miss out on the integration of the school subjects such as technology, biology, Swedish, maths, and art.

Below is a short list of what pupils will learn during the project and under which school subject each skill falls. The boxed texts are excerpts of the goals for grade 5 from the Swedish Curriculum for the Compulsory School System (Lpo 94).

Biology

Learn the names of different birds.

Learn basic facts on different birds such as how to identify them and what they prefer to eat.

Learn about different strategies employed by birds to find food: Do they eat at the bird table? Do they fly away with seeds to eat? Do they collect and hide seeds to eat at a later time? Do they prefer being alone when fetching their food?

National goals to be reached by all pupils by the end of grade five:

- Recognise and identify several common plants, **animals** and other organisms in the local environment and know their habitat requirements.

Technology

Learn the properties of different materials (closely related to chemistry).

Learn to use common tools.

Learn to make and use designs and blue-prints.

Learn to plan complex tasks and evaluate the results of chosen methods.

National goals to be reached by all pupils by the end of grade five:

- Be proficient in the use of several common tools and technical aids and be able to describe their functions…
- Be able to plan and build simple constructions under supervision.

Maths

Learn to measure lengths in mm, cm, and dm or using undefined units.

Learn to use addition, subtraction, multiplication, and division to solve practical problems.

National goals to be reached by all pupils by the end of grade five:

- Understand and be proficient in the use of **addition, subtraction, multiplication, and division.**
- Recognize patterns in sets of numbers and be able to determine an unknown variable in simple equations.
- Be proficient in counting with natural numbers—using mental arithmetic, pen and paper, or a calculator.
- Have a basic spatial awareness and be able to identify and describe some important aspects of geometrical figures and patterns.
- Be proficient in comparing, assessing and measuring **lengths**, areas, **volumes**, **angles**, masses, and **time** as well as being proficient in using blue-prints and maps.

Swedish

Learn to take notes and describe observations in written language.

Learn to plan and document a project in written language.

Learn computer editing skills (if you choose to use a digital camera for documentation and write text using a word processor).

National goals to be reached by all pupils by the end of grade five:

- Be proficient in reading and reading aloud: be able to understand the course of events and the message of novels and technical literature, be able to discuss reading experiences and reflect on texts.
- Be proficient in producing texts for different purposes as tools for learning and communication.
- Be able to orally recount a course of events in a vivid and understandable way.
- Be proficient in spelling, applying the most common grammatical rules, and using a dictionary.

Art

Learn to draw two and three-dimensional blue-prints.

Learn to draw birds using different techniques.

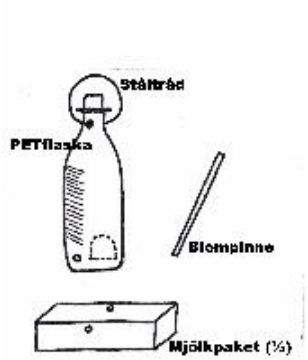
Learn to design and sculpt in three dimensions.

National goals to be reached by all pupils by the end of grade five:

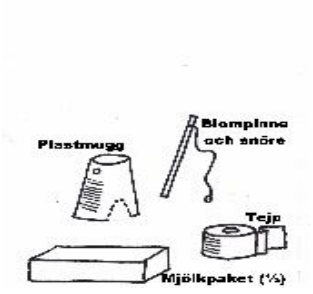
- Be proficient in creating images using different tools and techniques.

As mentioned, the above is just a selection of what pupils will learn by building the bird feeders—individually or in small groups. You will surely find other benefits of the theme yourself. One aspect that has not been mentioned is that learning is guaranteed to be fun!

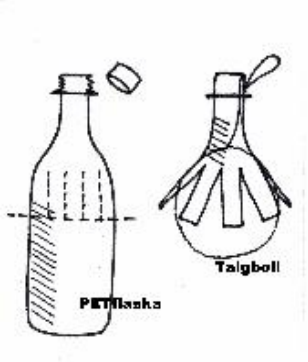
Ideas for Bird Feeders



Cut a small opening in the bottom of a plastic bottle and drill a hole on the opposite side. Cut a milk carton in half and make two holes at the middle of the base. Slip a thin wooden stick through the holes, fastening the bottle to the milk carton. Drill two holes at the top of the bottle and slip some steel wire through. Fill the bottle with seeds, screw the cap on, and hang out for the birds.

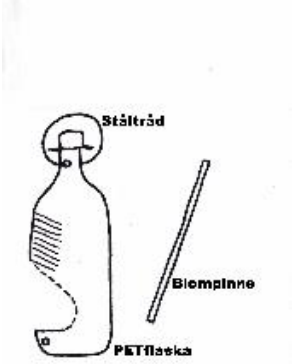


A slightly simpler version of the previous feeder. Cut an opening at the top of plastic mug and fasten it upside down to a milk carton using tape. Make holes in the mug for a small stick, slip the stick through the holes, and fasten some thread at each end of the stick to hang up the feeder. Remember to fill the mug with seeds before you tape it to the milk carton.

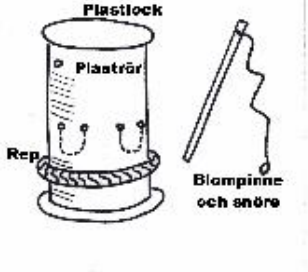


Saw along the dotted lines. Pull the flaps outward and insert a ball of tallow. Pull the string from the tallow ball through the top of the bottle and screw the cap on.

A more expensive version of the previous feeder. Buy a flower pot, paint it, insert a tallow ball, and pull the string from the tallow ball through the hole.



Saw along the dotted line and drill holes at the top and bottom of the plastic bottle. Slip the steel wire through the top holes and a thin wooden stick through the bottom holes. Fill with seeds and hang out.



Saw along the dotted lines and push the flaps inward. Glue the bottom on and tie a thin rope round the pipe (might need some glue as not to glide). Drill holes at the top of the pipe and slide a stick through. Tie some string to each end of the stick for hanging up the feeder. Fasten the top with tape on one side only to work as a hinge. Fill with seeds and hang out.

Five examples of bird feeders built by pupils. Feel free to use the designs for inspiration.

Demonstrating Different Bird Beaks

Using a clothes peg and a knife it is easy to demonstrate how the beaks of seed and insect eating birds differ and that the shape of the beak determines a bird's diet.

Use a knife to carve the sides of one end of a clothes peg so that it becomes thin and pointy like the beak of an insect eater.

A seed can be opened quite easily using the broad side of the clothes peg.

It is difficult to crack a seed open using the thin and pointy side of the clothes peg.

Bird Games

The Marsh Tit Game

This game is always popular with the pupils and illustrates the difficulties faced by winter birds. To survive the winter, some birds hoard food, among them the marsh tit. The marsh tit remembers where it has hidden seeds and can find the stored food during the winter.

In the game, most pupils play marsh tits that are to hide sunflower seeds for the winter. Since the marsh tit has such a small beak, each bird can only carry one seed at a time. Furthermore, the seeds must always be hidden above ground level so that they are not covered by snow.

Not all pupils play marsh tits, some will play great tits that try to steal the hidden seeds. Others will play sparrow hawks that on signal will swoop down and eat a marsh tit or a great tit. A bird that has been eaten must run 10 times around a tree before joining the game again. The sparrow hawk quickly becomes hungry and continues hunting.

Let the hawks swoop down two or three times and then end the game. Now let the pupils playing marsh tits find and count their hidden seeds, the pupil who has the most seeds win. Let the pupils change roles, so that those playing great tits or sparrow hawks now play marsh tits, and restart the game. After a few repetitions, gather the pupils to summarise what you have learnt.

Try explaining the challenges faced by a marsh tit during a year as a maths problem. Lining up pupils is a good way of visualising maths problems. One pupil might represent a male marsh tit, another a female marsh tit, and another few eggs or young birds. Let these pupils walk along a “timeline” and then take away those birds that die for one reason or another.

There is an incredible amount of things you can discuss based on this game reflecting the real toils of the marsh tit. Survival strategies are a major research area within biology so the game can be used both for six year olds and biology students at university.

The Bird Game (Adaptation of the Elk Game)

This game is played on a small open area or a field. Divide the class into two groups that start on opposite sides of the field. One group of pupils will play birds and the other group will play environmental factors such as food, nesting places/warmth, and water. Each environmental factor has a specific signal: to signal food you place both hands on your stomach, to signal nesting place/warmth you make a roof over your head using both arms, to signal water you put your thumb in your mouth. A bird with the need for a specific environmental factor will use the same signal to communicate this.

At the beginning of each round, the birds and environmental factors stand on opposite sides of the playing field facing outward so that they cannot see each other. Each pupil playing an environmental factor chooses to be food, a nesting place/warmth, or water and signals appropriately. Likewise, each bird chooses a specific need and signals appropriately.

On a given signal, all pupils turn around and the birds fly to an environmental factor matching their need, that is someone showing the same signal. Those birds that have their needs satisfied bring the pupil playing “their” environmental factor over to the bird side for the next round. Those birds that do not have their needs satisfied play environmental factors in the next round. Redundant environmental factors stay environmental factors during the next round.

Once the pupils have gotten the hang of this, the game can be made more complicated by adding a cat or a sparrow hawk. These will start on the side of the playing field during each round and will try to catch and eat birds flying to the environmental factor they need. Birds that get eaten play sparrow hawks or cats during the next round.

After a number of rounds, it will become clear how the bird population fluctuates around the carrying capacity of the environment that is the relative supply of environmental factors. This is good introduction to a discussion on how changes in our landscape affect the roosting possibilities or food supply for birds.

As a small incentive to work with the winter birds theme, the Nature School of Nynäshamn has initiated a competition to see which school class can identify the most bird species at their bird feeders.

The objective is to identify as many bird species as possible at the bird feeders during the last two weeks in Marsh. Remember that attracting birds can take some time so put out the bird feeders a couple of weeks in advance.

Use the attached list to keep track of which bird species you see. The list must be sent in to the Nature School of Nynäshamn no later than April 1 and can be sent using the school internal post service. The winner will be announced one week later.

Prizes!

First prize: The class that identifies the most bird species wins a pair of binoculars.

Second to fifth prize: A book of birds.

Good luck!

Recommended Bird Books (translated title in parenthesis)[1]

Bergengren/Björk: *Vinterfåglar kring vårt hus (Winter Birds at Our House)*
Bergenholtz: *Vid fågelbordet, vid fågelholken (At the Bird Feeder, at the Nesting Box)*
Berggren: *Talgoxen, Blåmesen (Great Tit, Blue Tit)*
Bergman Sucksdorff: *Mina första fåglar (My First Birds)*
Björk-Lofterud: *Fåglar I vår närhet (Birds in Our Neighbourhood)*
Bruun/Delin/Svensson: *Alla Europas fåglar i färg (Birds of Britain and Europe)*
Casta/Ullström: *Den vilda staden (The Wild City)*
Eriksson: *Skatprat (Magpie Talk)*
Falk/Kallenberg: *Barnens fågelbok 1 och 2 (The Children's Bird Book 1 & 2)*
Fakta i närbild: *Fåglar (Birds)*
Nilsson: *Den fräcka kråkan (The Cheeky Crow)*
Ströstedt: *Fanny och fåglarna (Fanny and the Birds)*
Ursing: *Fåglar, en fälthandbok (Birds, a Field Guide)*
Örtengren: *Fågelräddarna (Bird Savers)*
Audio CDs:
Andersson/Svensson/Zetterstöm: *Fågelsång i Sverige (Birds of Sweden)*
Arla/Mark Levengood: *It's in the Air, naturens meldifestival (It´s in the Air, the Song Contest of Nature)*

References

All bird images used in this guide were found at www.birdphoto.se and have been used with the consent of the photographers.

Examples of bird feeders were previously published in *Bi-lagan* (issue 1, August 2005).

[1] Titles translated from Swedish for illustrative purposes only. Books might not be available in English.

Winter Birds at the Feeder

Name ……..

Address ……..

Postal code and city …….

List of bird species:

		Highest number of simultaneous sightings			Highest number of simultaneous sightings
¨	Bohemian Waxwing	…….	¨	Crow	…….
¨	Robin	…….	¨	Starling	…….
¨	Blackbird	…….	¨	House Sparrow	…….
¨	Fieldfare	…….	¨	Tree Sparrow	…….
¨	Redwing	…….	¨	Chaffinch	…….
¨	Blackcap	…….	¨	Brambling	…….
¨	Marsh Tit	…….	¨	Greenfinch	…….
¨	Willow Tit	…….	¨	Goldfinch	…….
¨	Siberian Tit	…….	¨	Siskin	…….
¨	Crested Tit	…….	¨	Common Redpoll	…….
¨	Coal Tit	…….	¨	Hoary Redpoll	…….
¨	Blue Tit	…….	¨	Bullfinch	…….
¨	Great Tit	…….	¨	Hawfinch	…….
¨	Wood Nuthatch	…….	¨	Yellowhammer	…….
¨	Eurasian Jay	…….	¨	…….	…….
¨	Magpie	…….	¨	…….	…….
¨	Jackdaw	…….	¨	…….	…….
¨	Rook	…….	¨	…….	…….
¨	Grey-Faced Woodpecker	…….	¨	…….	…….
¨	Great Spotted Woodpecker	…….	¨	…….	…….

Additional reading material (for teachers)

The Eurasian Jay—Worth its Weight in Gold

Author: Tore Söderqvist

Can you put a price tag on a eurasian jay? The surprising answer is yes, given a specific context. The value, however, will not be universally applicable. Recent research on the role of the eurasian jay in the National Urban Park (Nationalstadsparken) in Stockholm showed that each bird was worth more than its weight in gold.

Furthermore, since our knowledge of ecosystems and our dependence on them is incomplete, we must also derive the value of a species using direct methods. Perhaps we are prepared to pay for the preservation of a bird simply because we find it beautiful.

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Although sources differ in how they type out the sound of the eurasian jay, all agree that the harsh, rasping screech makes the bird easy to detect. A teenage girl once told me it had a "punk sound" to it—a remark I believe was meant to be positive. Personally, I find the eurasian jay to be beautiful, secretive and reclusive—a combination that fascinates me. I love to watch it collecting acorns from the oak outside my window in autumn. Lately, I have learnt that the efforts of the bird are more beneficial to me than I had expected. When I told a friend that I very much enjoy watching the bird through my window he responded: "I'd have expected a slightly more specific value, you being an ecological economist. Why don't you put a price tag on it?" But is it possible to put a price tag on a bird? The answer is both yes and no; in the following text I will explain why and reveal the bird's value.

Finding the Value of Natural Assets

One of the most important tasks of ecological economists is to make estimates of the economical value of our environment. In order to do this, they must be equipped with knowledge of how ecological systems benefit people and society, in short: understand the production of ecosystem products and services. By ecosystem products we mean those well known products produced in ecological systems. The systems can, however, to a lesser or larger extent be operated by humans. Fish, timber, grain, and other products from fishing, agriculture and forestry are a few examples.

Ecosystems are also useful in less direct ways by providing services. Some examples are purification of air and water (e.g. nitrogen reduction in wetlands preventing over-nitrification of lakes and sees), protection against floods (e.g. the mangrove forest's barrier effect along tropical coasts), and pollination and seed dispersion done by insects and other animals. Good environmental quality, recreation possibilities, and experiences of nature also fall under services provided by ecosystems.

The value of these products and services can be quantified using economic models, a tool that aids finding the social and macro economic value of consequences of different policies and

projects. Economists put these consequences in terms of a changed supply of products and services. The economic value of a change is the amount of resources people are willing to give up in order for a positive change to be realized. Likewise, the economic cost of a change is the amount of resources people demand in compensation if a negative change is realized. The resources mentioned above are usually measured in money. If there is a change in the supply of products or services traded on a market, the actions of individuals on that market provide information on the trade-offs they are willing to accept. For instance, in order to enjoy Lars Jonsson's wonderful pictures and texts on birds I have to buy his book which means giving up part of my income.

However, for many ecological products or services there are no markets. In this case, we must use methods from ecological economy to find the economic value. One way is to find out how ecosystem services affect the supply of publicly traded goods, for instance by measuring the importance of pollination for a crop. Another example of this is that a deteriorated environmental quality can affect housing prices negatively and also affect people's choice of recreation—both resulting in real costs in terms housing prices or travelling costs measured in time and money. A different approach to finding the economic value is to use surveys or interviews and ask people about their willingness to pay, or what they demand as compensation, regarding changes in the environment.

No Universal Price Tags

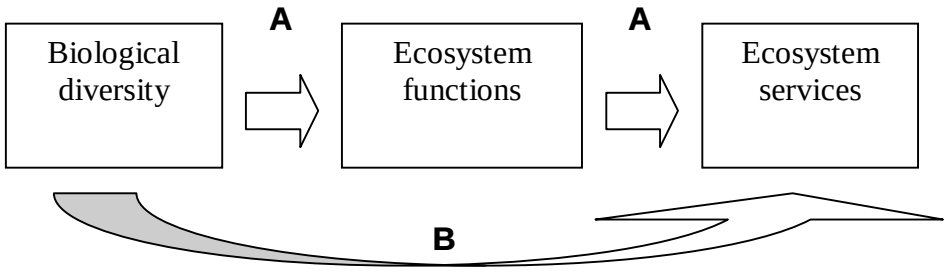
Economic value is often misunderstood. Sometimes it is forgotten that the economic value does not represent total value. Non-economic value inherent in the environment for ethical or social reasons should also be weighed into the evaluation of projects that change our environment. Another common mistake is that an economic value is seen as universal. This is a simple mistake to make, especially if the value is expressed per unit of ecosystem service, for instance euros per square metre of biotope or euros per kilo of nitrogen reduction. But in reality, the price tags are strongly connected to the context in which they were developed. This can make generalizations from "one small to another" difficult as well as generalizations from "the small to the large". Take for example the ecological service of providing fish to catch. In Stockholm's archipelago, the value of this service has been researched by finding the willingness to pay for an increased catch of important fishes such as perch, pike, and trout. This provides information on the value of projects that restore or protect the archipelago and in the long run increase each fisher's catch.

But does such a project provide any information on the value of similar projects in the archipelago of Bohuslän in southwest Sweden ("from one small to another")? It might if both the ecological cause-effect chains and the value of leisure fishing in Bohuslän's archipelago are similar to those in Stockholm. But there is neither perch nor pike in the salt water of Bohuslän and this alone introduces problems of generalization. And can the results from Stockholm be applied to projects that encompass the whole of Sweden's east coast and Finland's west coast ("from the small to the large")? Apart from differences in environmental factors and the difference in the value placed on ecological services by people in separate locations, generalization here is hindered by the fact that a large scale project might have quite different side effects than a small scale project in Stockholm's archipelago.

This does not mean that it is impossible to make generalizations about the value of a product or service, but that such generalizations must be made under careful consideration and with great caution. In essence, an ecological economic value does not apply to the environment itself, but only to its usefulness in the context of a specific project and its consequences. Thus, the values cannot be decoupled from the project and the context.

Two Ways of Assessing the Value of Biological Diversity

This far we have dealt only with the value of an ecosystem's products and services. When we come to biological diversity, our task gets more complicated. Biological diversity is one of the most difficult aspects of ecological economy. The reason for this is the lack of knowledge of how biological diversity affects the production of ecosystem services. There is a need for knowledge on the cause-effect chains marked A and B in the figure below. Chain A shows the indirect benefits of biological diversity in terms of its effects on how the ecosystem functions. An interesting aspect here is the effect of biological diversity on resilience, meaning the ecosystems ability to resist and recover from environmental disturbances. If biological diversity has a strong effect on resilience it would mean that biological diversity reduces the risk of disturbances in the production of ecosystem services. If a disturbance affects a specific species, another one can take its place.



There is insufficient knowledge on the indirect benefits of a certain species in an ecosystem (cause-effect chain A). Therefore, ecological economists also use direct benefits to assess the value of a species (cause-effect chain B). Direct benefits might be aesthetical, the species is beautiful, or ethical, the species has a right to exist.

Direct benefits, chain B, might arise because people appreciate biological diversity for aesthetical, ethical, or any other reason. For a person who appreciates eurasian jays, a forest without the bird would simply be more dull. As long as our insufficient knowledge keeps us from assessing all indirect benefits (how ecosystems work), biological diversity must also be valued using chain B.

Let us use the eurasian jay in the National Urban Park in Stockholm to demonstrate the direct and indirect benefits defined above. One way of finding the value of the eurasian jays in the park would be to ask people how much they are willing to pay to preserve the bird. Similar studies of the value of an individual species have been done may times before, in Sweden most notably for white-backed woodpeckers and wolves. If people do not know about or understand the role of the eurasian jay in the ecosystem, the value found using this method will be decided by factors such as how many people perceive the bird to be beautiful and how many people think it has a right to live (chain B).

The Eurasian Jay as a Tree Planter

Although the above is a fully valid way of assessing an economic value, it does not necessarily tell us the whole truth. It is likely that most people do not know that the eurasian jay also performs the important ecosystem service of planting oaks. During autumn, the 40 pairs of eurasian jays in national urban park collect a large number of acorns and hide them by burying them on a suitable planting depth. Studies of the eurasian jay suggest that each bird will hide 5 000 to 10 000 acorns per year. Their ability to find the hidden supplies is

phenomenal, but some acorns are forgotten and left to sprout. Thus, the eurasian jay effectively contributes to the continued survival of the park's oaks since it both disperses and "plants" the acorns.

Acorns that lie directly on the ground will to a large extent be eaten by animals and if an acorn sprouts directly under an oak, the new plant will have trouble growing in the shadow of the larger tree. The oak is a character species in the Urban National Park and this is something I and many other park visitors would like to remain true for years to come. So if the eurasian jay was not planting new oaks, we would have to perform the same task ourselves, an endeavour costly in both time and money. The economist Cajsa Hougner has calculated the cost of planting oaks using manual labour and divided this cost onto each par of eurasian jays in the park. The result was that the service provided by the birds is worth at least 3 500 EUR per pair of birds, and probably four times that amount. Although these are rough calculations they show what might possibly be overlooked if chain A is not properly investigated.

Revealing Hidden Ecological Services

Carl von Linné noticed the eurasian jay's industrious collecting and hiding and remarked: "our creator's house-keeping is clearly shown and in this way he wanted the acorns to be dispersed". Today this is called an ecosystem service and as an ecological economist I hope that such hidden ecological services continue to be revealed.

Lastly, as promised, an explanation of the title of this text: A eurasian jay weighs approximately 170 g. The price of gold is currently about 10 EUR / g. This means that 170 g of gold costs 1 700 EUR—so the Euraisan Jay really is worth its weight in gold! Remembering the common misconceptions discussed earlier; keep in mind that this number does not apply to the eurasian jay as such but only to its role as acorn disperser in the Urban National Park of Stockholm. What the eurasian jay outside your window is worth I cannot tell.

Reading Tips (translated title in parenthesis)[2]

Sjöberg, Fredrik ed. (2001): *Vad ska vi med naturen till (What Use is Nature?),* Nya Doxa.

Söderqvist, T; Hammer, M & Gren, I-M (2004): *Samverkan för människa och nature—en introduktion till ekologisk ekonomi (Cooperation of Man and Environment—An Introduction to Ecological Economy),* Studentlitteratur, Lund.

Cajsa Hougner's work was a piece of the Swedish part of The Millenium Ecosystem Assessment, see www.ctm.su.se/MA

I would like to thank Johan Colding, Thomas Elmqvist, Patrik Rönnbäck, and Max Troell for there knowledge and insight.

[2] Titles translated from Swedish for illustrative purposes only. Books might not be available in English.