RESULTS OF POND ANALYSIS
Emys orbicularis, Bombina bombina and *Triturus cristatus*
FOR PRACTICAL USE

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Selected activities in NE-Poland

- EKOFUND/DANCEE: Bombina bombina in Podlasie(1998-2002)

- LIFE turtle and amphibians (2005-2009)
- LIFE lesser spotted eagle (2010-2015)

- EIA of road Olsztyn-Biskupiec (2009)
- EIA of Elbląng ring road (2009)

Content

- Data collection and methods
- Overview of ponds checked
- Results of single pond parameters - practical use in pond and wetland restoration and creation
- Results of sourounding habitats
- What did we do in the project

Data form preparation

- Discussed and agreed on study tours 2005-07
- Norbert Schneeweiss, Heidrun Beckmann, Martina Meeske, Mariusz Rybacki, Lars Chr. Adrados and Lars Briggs

Data collection

- All partners took part in data collecting from 274 ponds in the project areas and 31 ponds from study tour areas in Denmark and Germany
- Minimun 12 persons took part

Field methods

- *Emys orbicularis* adult and juveniles: visual and traps
- *Triturus cristatus* adult/juveniles: visual, traps and dip-nets
- *Triturus cristatus* larvae: dip-nets
- *Bombina bombina* adult/juveniles: sound and visual
- *Bombina bombina* larvae: dip-nets

Data analysis

- Done by Lars Briggs, Ostap Reshetylo and Lars Chr. Adrados

- Comments by Martina Meeske

- Results still have to be commented and evaluated by the group of experts with Norbert Schneeweiss, Heidrun Beckmann, Martina Meeske, Mariusz Rybacki, Renata Kosinska, Grzegorz Gorecki, Giedrius Trakimas, Dalia Bastyte

- There were investigated 274 ponds in total: 104 ponds checked in Poland, 47 in Lithuania and 123 in Germany.

- The total data analysis all over the North European lowlands is presented here, paying attention to the significant results and most interesting trends in the data

- It is suggested how to use the results in practice

Emys orbicularis

Country	Total # ponds	Ponds without	Ponds w/ young	Ponds w/ adults	Ponds (young + adult)
Poland	104	78	1	19	6
Lithuania	47	31	0	12	4
Germany	123	115	-	8	-
Total:	274	224	1	39	10

Triturus cristatus

Country	Total # ponds	Ponds without	Ponds w/ larvae	Ponds w/ adults	Ponds (larvae + adult)
Poland	104	73	22	4	5
Lithuania	47	47	-	-	-
Germany	123	105	-	18	-
Total:	274	225	22	22	5

Bombina bombina

Country	Total # ponds	Ponds without	Ponds w/ larvae	Ponds w/ adults	Ponds (larvae + adult)
Poland	104	74	2	28	0
Lithuania	47	36	-	11	-
Germany	123	74	-	49	-
Total:	274	184	2	88	0

- Ponds and surrounding habitats were checked for a variety characteristics such as physical parameters of the ponds, geology and water quality, composition of surrounding habitats, biotic factors etc.

Investigated pond parameters

1. **Physical parameters of ponds**
   - 1.0. Type
   - 1.1. Size
   - 1.2. Maximum depth
   - 1.3. Slopes
   - 1.4. Shallow zones

2. **Geology and water quality**
   - 2.1. Sediment
   - 2.2. Water clarity and color

3. **Surrounding habitats**
   - 3.1. Buffer zone
   - 3.2. Grazing
   - 3.3. Terrestrial habitat within a 50 m around
   - 3.4. Terrestrial habitat within 50-500 m around
   - 3.5. Distance to the forest
   - 3.6. Distance to the other ponds

4. **Biotic factors**
   - 4.1. Shade provided by trees
   - 4.2. Vegetation
   - 4.3. Algae

5. **Other fauna**
   - 5.1. Fish
   - 5.2. Birds

- Gathered and cathegorized data were analyzed by means of data mining. Analyzing the significance of obtained results we used Chi-square test based on the null hypothesis theory. In some cases we applied Yate's correction factor ($\chi2_{0,5}$) when estimating significance of the results.

Results

- The results provide rough overwiew of habitat characteristics in NE lowland – but interresting still.

- More detailed studies of single species as in LIFE cristatus (2004-08) provide more precise data (Diversity and Distributions, (Diversity Distrib.) (2009) 15, 692–700).

E.orbicularis, T.cristatus, B.bombina

1. Physical parameters of the ponds

- The most occupied pond size type for *E.orbicularis* is 500-2000 sq m (28-31% species presence).

- Some tendency to prefer smaller ponds (less than 500 sq m) can be noticed in *T.cristatus* larvae occupancy (36-42%).

- Big ponds (more than 2000 sq m) are found out to be preferable for adult *B.bombina* (57-59% occurrence) what is very significant ($\chi 2 = 17.489$, p = 0.0016).

1.2. Size of the pond
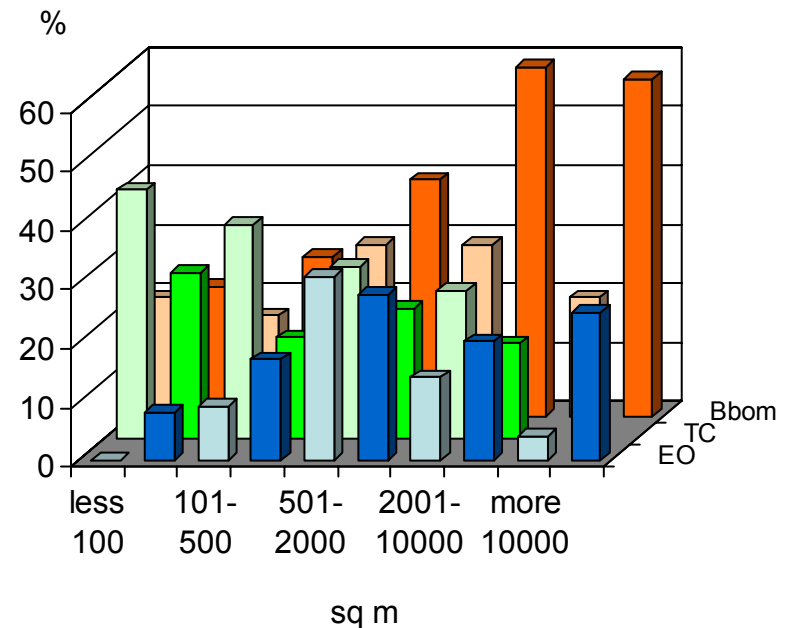
Light colors – young turtles and amphibian larvae
Bright colors – adult animals

Size conclusion

- *Emys orbicularis*:

  Make ponds 500-2000 m^2

- *Triturus cristatus*:

  Make ponds better less than 500 m^2

- *Bombina bombina*:

  Make ponds better larger than 2000 m^2

# Bagienko, Poland
B.bombina calling, *E.orbicularis* ad+juv

E.orbicularis, T.cristatus, B.bombina

1. Physical parameters of the ponds

- Depth of the pond for *E.orbicularis* is very significant factor and has to be no less than 0,5 m. Preferably more than 1 m (12% occurrence of youngs and 34% of adults).

- The analysis shows extremely significant preferences for 0,5-1 m depth for *T.cristatus* larvae (46% occurrence) and more than 1 m depth for adults (24%).

- Water depth has to be at least 0,5 m for adult *B.bombina* (45-49% occurrence).

1.3. Max depth of the pond
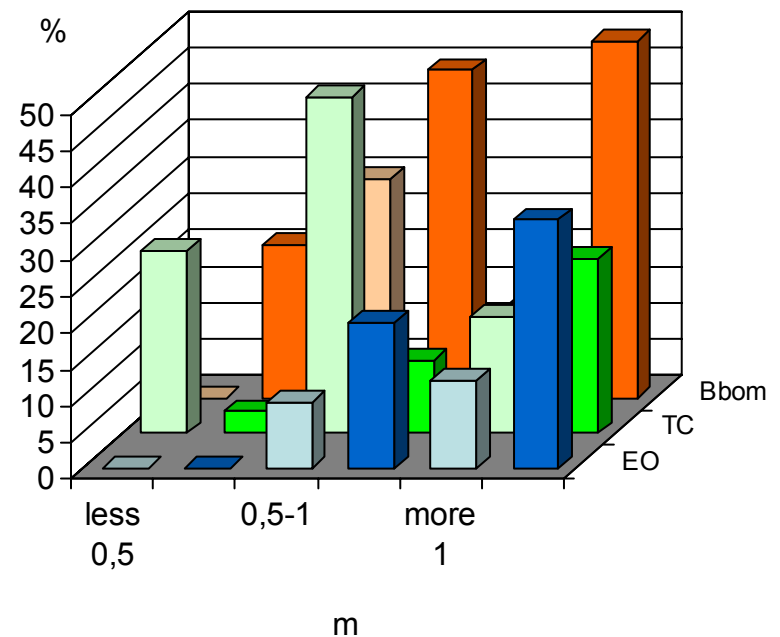
Light colors – young turtles and amphibian larvae
Bright colors – adult animals

Depth conclusion

- *Emys orbicularis*:

  Make ponds minumun 0,5 and better deeper than 1,0 m

- *Bombina bombina*:

  Make ponds deeper than 0,5 m

- *Triturus cristatus*:

  Make ponds better 0,5-1,0 m deep

E.orbicularis, T.cristatus, B.bombina

1. Physical parameters of the ponds

- Occurrence of young and adult *E.orbicularis* seem to be opposite: first ones are twice common in ponds with lower slopes (15%), the others prefer steeper slopes (mostly sunny ones) to the same extent (62%).

- The analysis doesn't show any significant dispersal for *T.cristatus.*

- The frequency trend of pond slopes inclination shows the lower slopes are the higher adult *B.bombina* occurrence is.

1.4. Pond slopes inclination
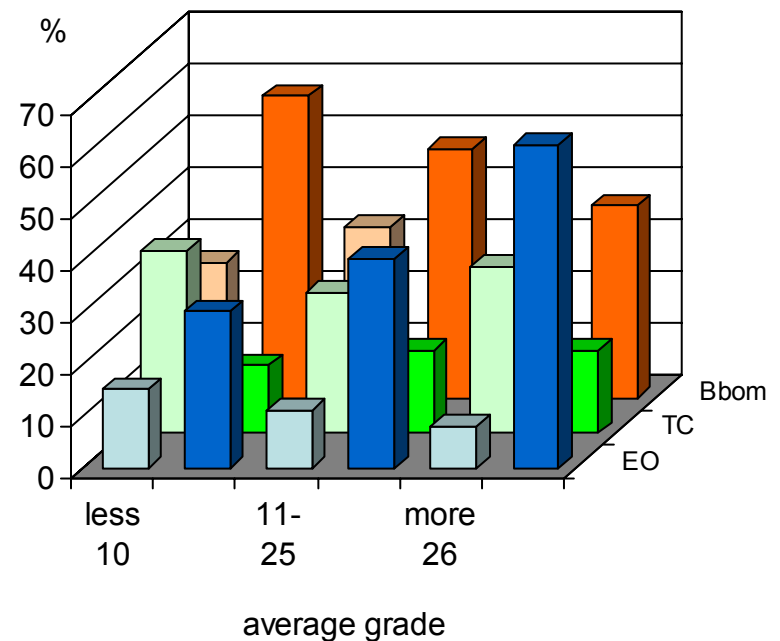
Light colors – young turtles and amphibian larvae
Bright colors – adult animals

Slope conclusion

- *E.orbicularis* adults:

  Make ponds with some steep slopes (sunexposed) or add dead wood

- *E.orbicularis* juveniles:

  Make ponds with flat slopes

- *T.cristatus*:

  Slope type has little influence

- *B.bombina*:

  Make ponds with flat slopes

Kolonia Rzeck, Poland
## *T.cristatus* eggs, *B.bombina* calling

E.orbicularis, T.cristatus, B.bombina

1. Physical parameters of the ponds

- Conditions seem to be optimal for *E.orbicularis* youngs if the pond shallow zone area is 11-25% (17% occurrence) and up to 25% for adults (44%).

- There are no significant differences between *T.cristatus* preferences for shallow water noticed.

- Conditions seem to be more optimal for both *B.bombina* adults (73% occurrence) and larvae (40%) if the shallow water zone exceeds 25%.

1.5. Shallow water zone (0-30 cm)
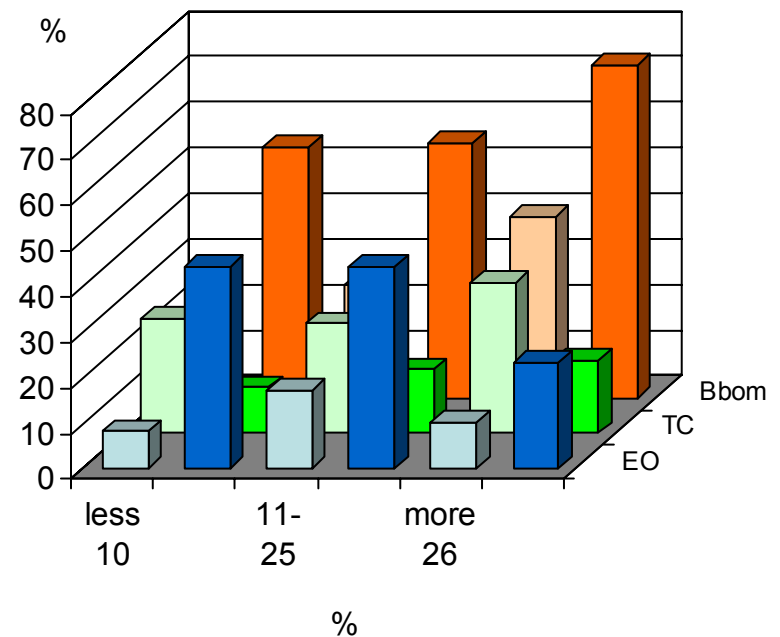
Light colors – young turtles and amphibian larvae
Bright colors – adult animals

Shallow zone conclusion

- *E.orbicularis* adults:

  Make ponds with shallow zones from 0-25% cover

- *E.orbicularis* juveniles:

  Make ponds with shallow zones 11-25% cover

- *T.cristatus*:

  No preference

- *B.bombina* adult and larvae:

  Make ponds with shallow zone more than 25% cover flat slopes

Shallow water below nesting slope

Meteliu, Lithuania

E.orbicularis, T.cristatus, B.bombina

2. Geology and water quality

- The criterion doesn't have any significant influence upon the occurrence of adult *E.orbicularis* ($\chi2 = 0.890$, p = 0.6409).

- Larvae of *T.cristatus* with the highest frequency were found in clear water ponds (38%) while the highest occupancy of adults was recorded in brown waters (24%).

- The preferred water quality both for *B.bombina* larvae (32%) and adults (55%) is clear.

2.2. Water clarity
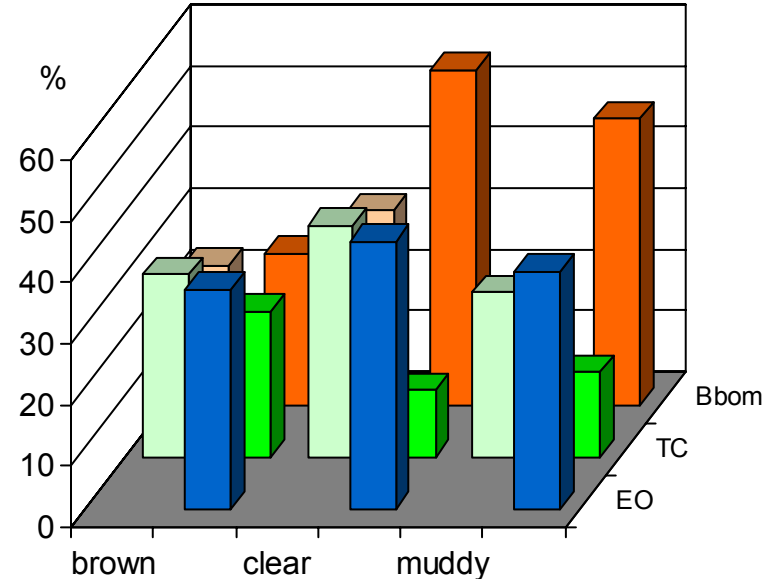
Light colors – young turtles and amphibian larvae
Bright colors – adult animals

Water quality conclusion

- *E.orbicularis*:
  Water quality has no influence

- *B.bombina* adult and larvae: make clear water
  Adult occupy also muddy water

- *T.cristatus* larvae:
  Make clear water > brown water > muddy water.
  Adult:
  Make brown water > clear water > muddy water.

Before: Overgrown moor

Meteliu, Lithuania

After: shallow and deep ponds

Meteliu, Lithuania

Order of surroundings

- Buffer zone
- Distance to forest
- Distance to pond
- 0-50 and 50-500 m
- Grazing

E.orbicularis, T.cristatus, B.bombina

3. Surrounding habitats

- The highest occupancy of *E.orbicularis* youngs was recorded in the ponds with wide buffer zone (more than 50 m) (42%).

- *T.cristatus* was rather low in case of narrow buffer zone (0-9 m) (up to 7% occurrence) compare to the wider zones, especially on larvae stage (31-37%).

- Only *B.bombina* larvae show extremely significant positive dependence between the width of buffer zone and occurrence of the larvae (34% in case of more than 50 m wide buffer zone).

3.1. Buffer zone (area of any type of habitat around the pond, except cultivated land)
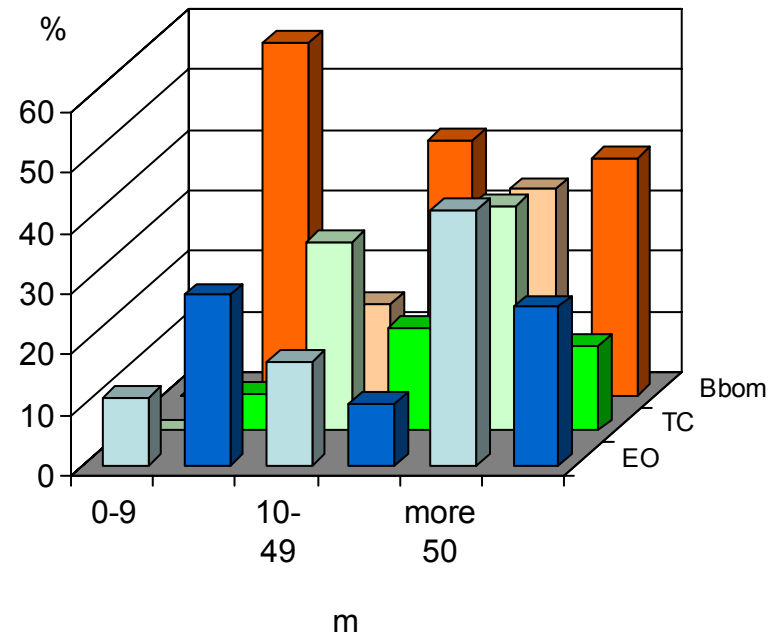
Light colors – young turtles and amphibian larvae
Bright colors – adult animals

Buffer zone to cultivated land conclusion

- *E.orbicularis* adult and juvenile: make more than 50 uncultivated land near pond

- *B.bombina* larvae:

Make 50 m uncultivated land

- *T.cristatus* adult and larvae:

Make more 50 m uncultivated land. Especially important for larvae.

# Purchase of nesting site and buffer zone for extensification of landuse Germany

E.orbicularis, T.cristatus, B.bombina

3. Surrounding habitats

- Occupancy of adult *E.orbicularis* is significantly higher if the distance to the forest doesn't exceed 50 m ($\chi2 = 11.913$, $p = 0.0077$).

- In spite of insignificance of the analyses for *T.cristatus*, the shortest distance (0-9 m) seems to be important for the species, especially for larvae (33% occurrence).

- Clear growing occurrence frequency trend towards longer distance to the forest from ponds (up to 200 m) for *B.bombina* larvae (35%) and adults (92%) was got.

3.5. Distance between the pond and the forest
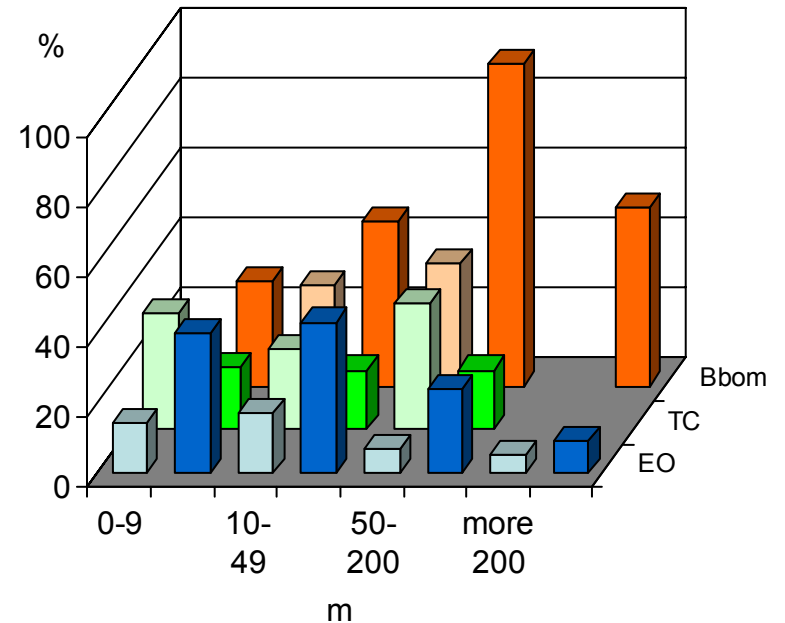
Light colors – young turtles and amphibian larvae
Bright colors – adult animals

Distance to forest

- *E.orbicularis* adult and juvenile: Prefer less than 50 m to forest.

  Which forest habitats to promote for *E.orbicularis* ???

  Wet forest ???

- *T.cristatus* adult and larvae:

  Always 0-200 m to forest (this study)

- *B.bombina* (ad+L):

  Prefer 50-200 m to forest.

  Which forest ???

E.orbicularis, T.cristatus, B.bombina

3. Surrounding habitats

- There are bit higher occurrence values in 0-200 m zone for *E.orbicularis* youngs (20-21%) and in 0-500 m for adults (54-62%) compare to the longer distances.

- Both *T.cristatus* larvae (47%) and adults (17%) have the highest occupancy in the ponds when distance to the closest ponds is less than 100 m (χ2 = 11.414, p = 0.0097 for larvae).

- The highest occupancy of *B.bombina* adults (73%) was recorded in the ponds with neighbor ones in 100-200 m (χ2 = 9.889, p= 0.0195) in Poland only.

3.6. Distance between the investigated pond and other ponds
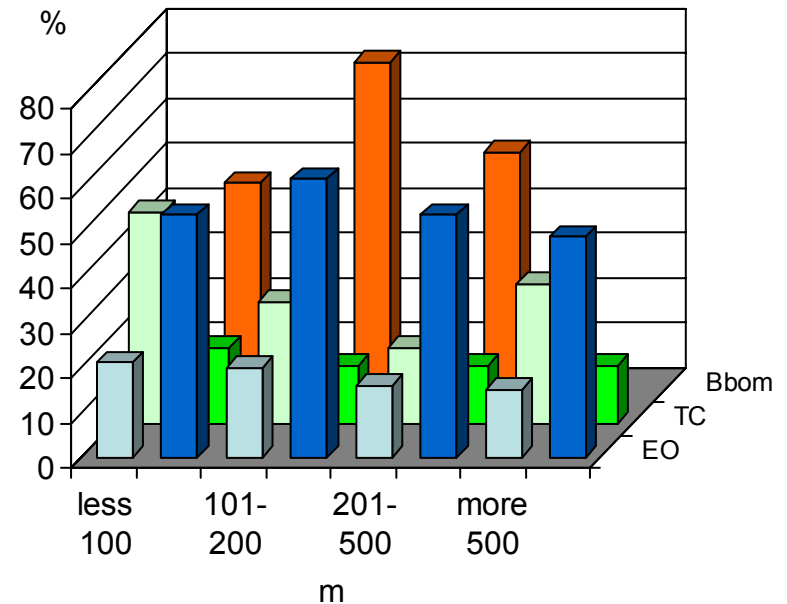
Light colors – young turtles and amphibian larvae
Bright colors – adult animals

Distance to other ponds

- *E.orbicularis* adults and juveniles:

  Youngs are more often present if ponds are within 200 m, adults 500m.

  Better increase pond density for all 3 species

- *T.cristatus* larvae: Significant that other ponds should be within 100 m.

- *B.bombina* (ad): Significant that other ponds should be within 200 m.

E.orbicularis, T.cristatus, B.bombina

3. Surrounding habitats

3.3. Terrestrial habitat within 50 m

- **Dead wood** (58% cases), **shrub** (44%) and **deciduous forest** (46%) are the most important nearest habitat surroundings for *E.orbicularis* adults.
- **Dead wood** (39%, 18%), **meadow/fen** (41%, 20%), **common dry grass** (46%, 25%) for both *T.cristatus* larvae and adults have the highest presence.
- High *B.bombina* larvae occurrence is in case of **meadow/fen**, **shrub**, **deciduous forest** and **common dry grass** presence (24-29%), and field and **shrub** (56-57%) for adults.

3.4. Terrestrial habitat between 50-500 m

- Coniferous forest (42%), meadow/fen and common dry grass (39% each) are the most frequent further habitat surroundings for *E.orbicularis* adults.
- The lowest while insignificant occupancy of *T.cristatus* was noticed if coniferous forest is present (14% for larvae and 7% for adults).
- The analysis of terrestrial habitat composition in radius 50-500 m for adult *B.bombina* occurrence doesn't show any significant dependence ($\chi2 = 8.061$, $p = 0.2337$).

How to improve surroundings

0-50 m: Add missing habitat components

- *E.orbicularis*: add dead wood to pond banks, add nesting sites, add deciodius forest.

- *T.cristatus*: add dead wood and grasslands

- *B.bombina*: add grasslands

50-500 m

- Actions within 50 m from ponds are most important.

- *B.bombina*: Important with forest somewhere within 50-500 m from pond.

E.orbicularis, T.cristatus, B.bombina

3. Surrounding habitats

- Absence of pond grazing was found to be significantly important for adults of *E.orbicularis* (40% occurrence) ($\chi2_{0,5}$ = 7.259, p = 0.0081).

- Pond grazing looks to have a bit negative influence over the occurrence of *T.cristatus* larvae while it is not proved as significant.

- Clear assumption can be made in case of *B.bombina*: both larvae and adults are much more frequent in grazed ponds while the results are considered to be not significant.

3.2. Grazing of pond
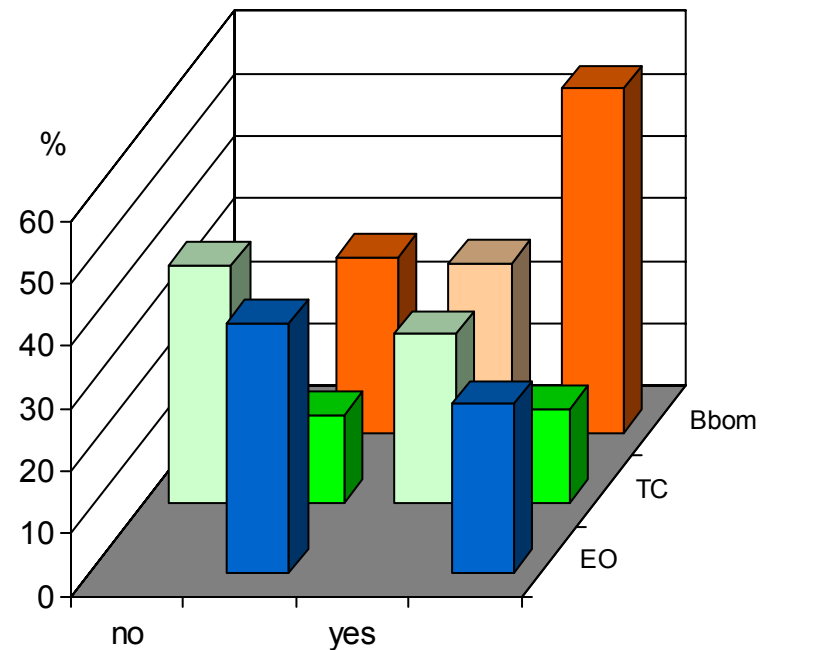
Light colors – young turtles and amphibian larvae
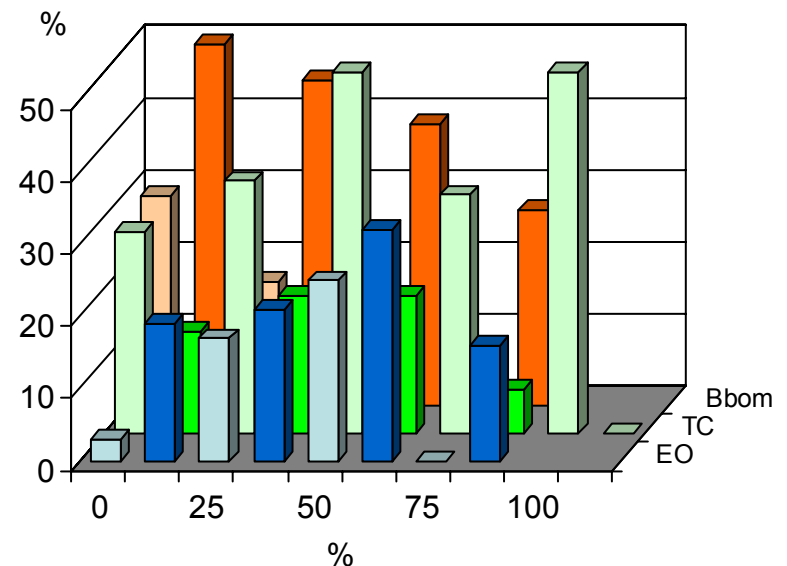Bright colors – adult animals

Grazing conclusions

- *E.orbicularis* adult and juvenile:

  Prefer no grazing.

  Grazing must be planned in details not to harm.

- *T.cristatus* adult:

  No influence

- *T.cristatus* larvae: sligthly negative.

- *B.bombina* (ad+L):

  Prefer grazing and it should be planned

E.orbicularis, T.cristatus, B.bombina

4. Biotic factors

- The result is considered to be significantly important for *E.orbicularis* youngs as their occurrence is higher (17-25%) if the shade is 25-50%. Adults seem to be more often in half-shaded ponds (32%).

- Optimal shade for *T.cristatus* is 25-75%. The conclusion is considered to be very significant for both larvae (33-50% occupancy) and adults (19%).

- The less shade (0%) the better conditions for *B.bombina* larvae and adults are (29% and 50% accordingly) ($\chi2_{0,5}$ = 5.786, p = 0.0173 and $\chi2$ = 33.830, p = 0.0001).

4.1. Shade provided by trees over the pond

Light colors – young turtles and amphibian larvae
Bright colors – adult animals

Shadow on ponds

- *E.orbicularis* adult: occur in all ponds but more often in 50-75 % shaded.

- *E.orbicularis* juveniles: occur with less than 50% shade.

- *T.cristatus* adult and larvae: create 25-75 % shade.

- *B.bombina* (ad+L):

  The less shade the better.

  Larvae only found in < 25% shade.

Lutynowo, Poland
T.cristatus eggs, *E.orbicularis* ad

Agena-restored pond and removed tree - Germany

E.orbicularis, T.cristatus, B.bombina

5. Other fauna

5.1. Fish in the pond

- Fish look indifferent criterion for young *E.orbicularis*, but occurrence of adults looks to be much higher in the ponds with fish (36%), compare to the ponds without fish (12%).

- Significant conclusion about fish presence in the ponds can be made for *T.cristatus* larvae: much higher occurrence in fishless ponds (39%) compare to those with fish (13%).

- *B.bombina* larvae was found only in ponds without fish (9%), whereas adults inhabit both pond types (36% and 49%).
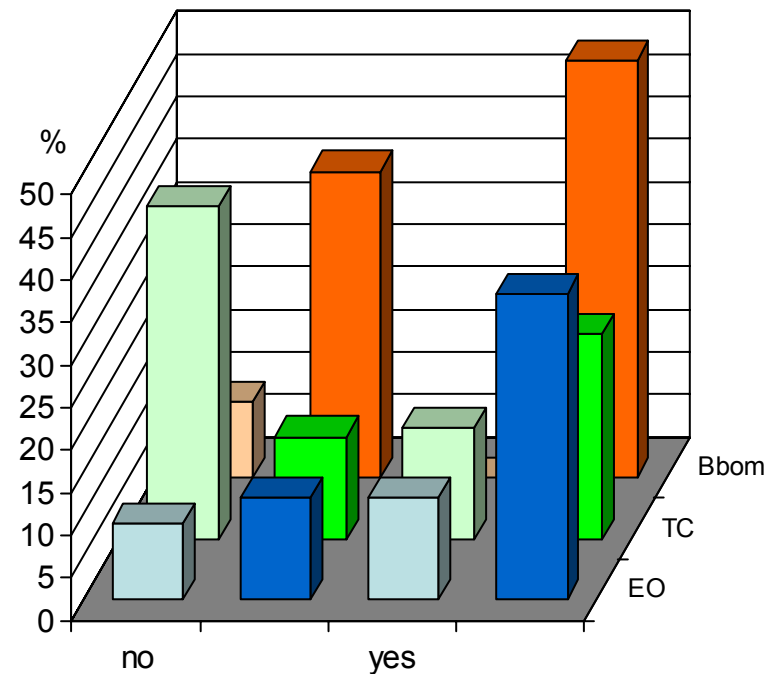
Light colors – young turtles and amphibian larvae
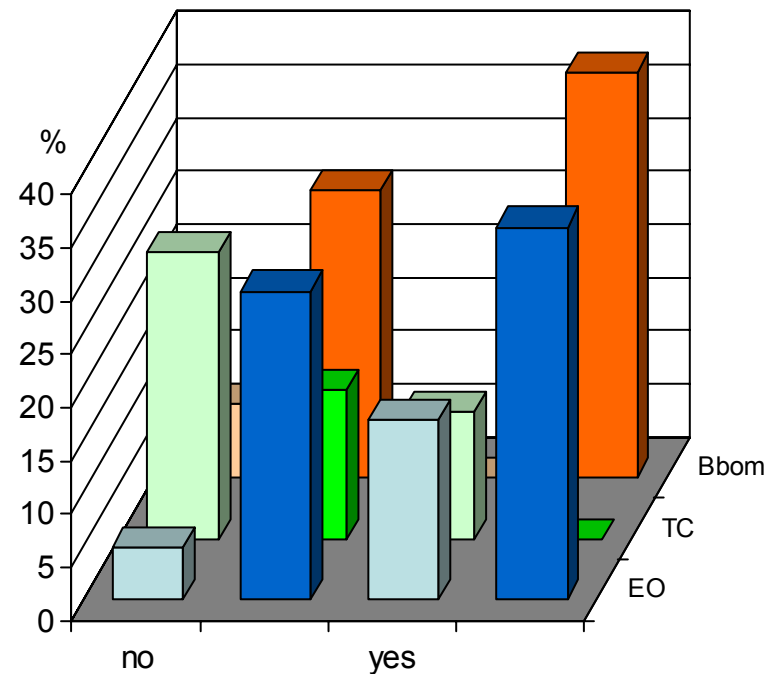Bright colors – adult animals

Fish in ponds

- *E.orbicularis* adult: occur much more in ponds with fish.

- *E.orbicularis* juveniles: occur equal in ponds with fish and without fish.

- *T.cristatus* larvae: Fish can not be present (significant)

- *B.bombina* (larvae): Larvae only in ponds without fish

- Adult Bb and Tc also occur with fish

E.orbicularis, T.cristatus, B.bombina

5. Other fauna

- No significant dependence between *E.orbicularis* existence and birds presence in the pond was found, while results, especially for young, show some increasing tendency (5 and 17%).

- Result for *T.cristatus* on the given parameter show statistically significant lower occurrence for larvae ($\chi2_{0,5}$ = 11.253, p = 0.0008) but not for adults ($\chi2_{0,5}$ = 2.250, p = 0.1673).

- The analyses of bird presence parameter (foraging mostly) for both larvae and adult of *B.bombina* are considered to be not statistically significant ($\chi2_{0,5}$ = 2.564, p = 0.1233).

5.2. Birds in the pond

Light colors – young turtles and amphibian larvae
Bright colors – adult animals

Birds in ponds

- *E.orbicularis* adult and juvenile: birds seems no problem
- *B.bombina* adult: birds seems no problem

- *T.cristatus* larvae: Try to avoid birds.

  No nest boxes for ducks

- *B.bombina* larvae: Occur only in bird free ponds (not significant)

Most critical factors

- *Emys orbicularis*:

  A lot of water:

  Minimum size ponds of 500-2000 m^2, with shallow zones and sun.

  Good nesting sites.

  Forest nearby.

  50 m buffer zones.

- *Bombina bombina:*

  A lot of clear water and some ponds without fish. Grazing and forest.

- *Triturus cristatus*:

  Ponds without fish. A lot of forest <200m away.

Lithuania

- 50 m zones often occur already
- Different pond types created in total 70.
- Nest sites created

- *B.bombina* and *T.cristatus* benefits from the ponds.

Germany

- 100 ha land bought that secure 50 m zones

- Different pond types created

- Nest sites created

- *B.bombina* and *T. cristatus* benefit from the ponds.

- Specific fish free ponds created for *B.bombina* and *T.cristatus*.

NE Poland

- Different pond types created but mostly hectare large floodings (>20)
- Nest sites created for *E.orbicularis*

- *B.bombina* and *T.cristatus* benefits from the ponds.

West Poland

- Different pond types created
- Nest sites created
- Still important to create buffer zones

- *B.bombina* and *T.cristatus* benefit from the ponds.

Bialowieza

- Nest sites created for *Emys orbicularis*.

- Small fish free ponds created for *T.cristatus*