HPDA service for estimating the brown bear population in Bulgaria

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Motivation

- The Habitat directive requires a strict protection of the species and declaration of special protected areas for conservation of its habitats.

- Brown Bear (Ursus arctos) is a priority species for conservation of mammals in the European Union. Conservation status: in Bulgaria endangered EN [C2a (i)], BA-II, III, International: Beck-II; CITES-II; DH-II, IV.

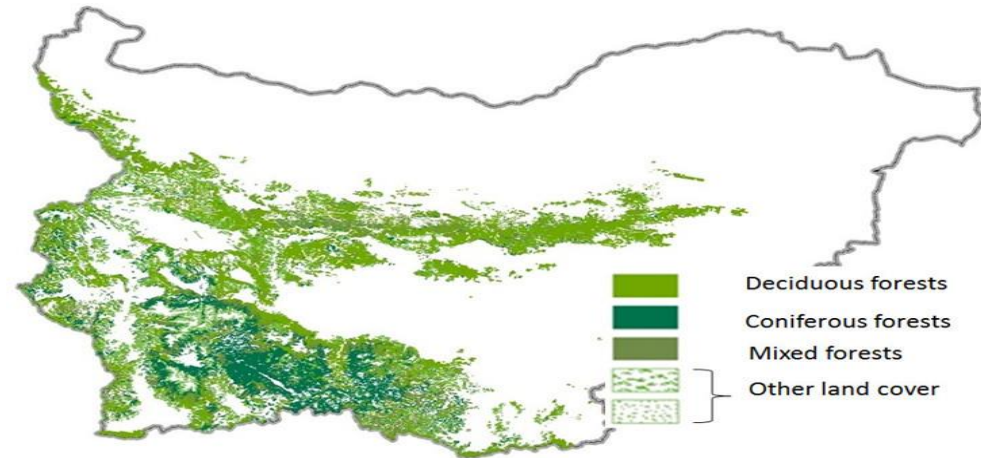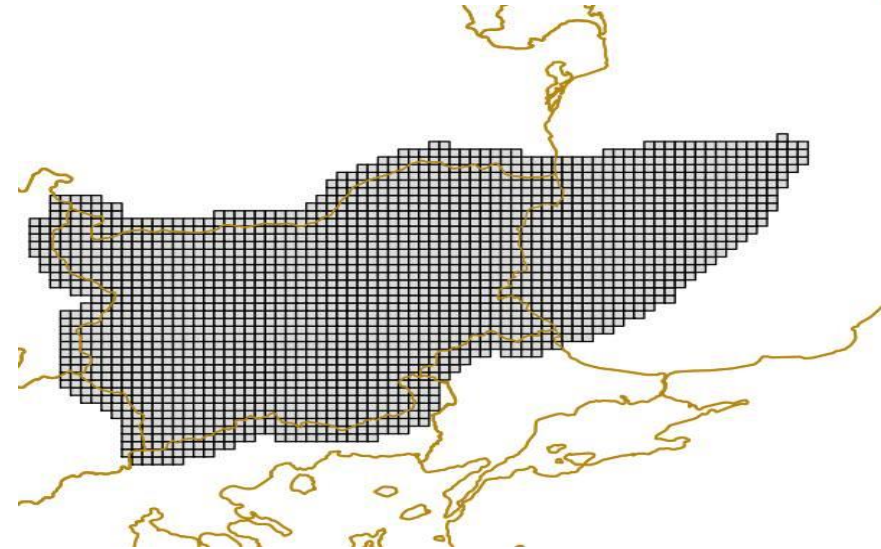- Red Data Book of the Republic Bulgaria, Vol. 2 – Animals, Sofia, 2011.

  http://e-ecodb.bas.bg/rdb/en/
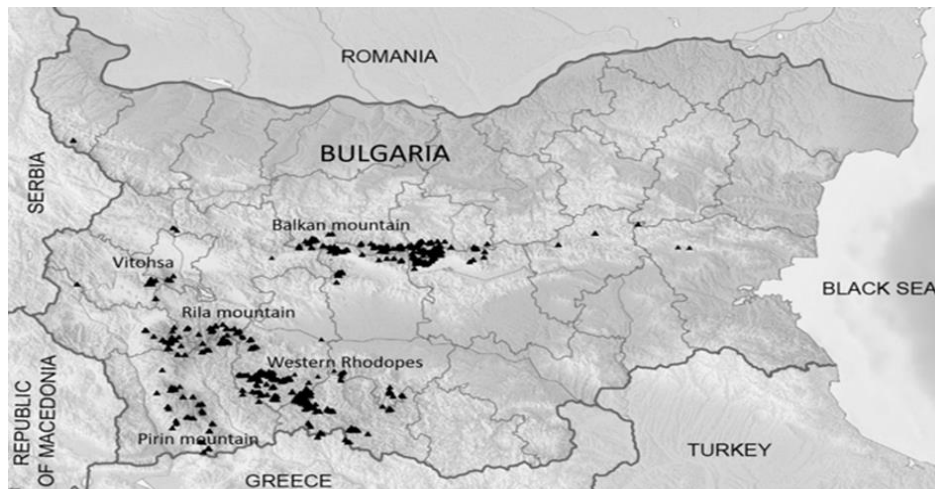
National monitoring

National Monitoring at the main mountain's habitats (2016):

- **Width/length of the front footprint and/or back footprint**   **79**
- **Excrements**   **75**
- **Found bear marking**   **26**
- **A place where the bear has fed itself**   **8**
- **Visual observation of a bear**   **17**
- **Found winter dens**   **3**
- **Bear bed**   **1**
- **Total: GPS coordinates of all bear's traces/signs**   **209**

Deciduous forests
Coniferous forests
Mixed forests
Other land cover

Number of grids in each subpopulation area

Areas for Monitoring	ETRS89 Grids 10x10 km	Number
Vitosha-Verila-Plana	E541N226; E541N225; E540N226; E540N225; E540N224; E540N223; E541N223;E541N224;E542N224; E542N225	10
Rila	E540N220; E540N221; E540N222; E541N219; E541N220; E541N221;E541N222; E542N219; E542N220; E542N221; E542N222; E542N223;E543N219; E543N219; E543N220; E543N221; E543N222; E544N220; E544N221; E544N222; E544N223; E545N220; E545N221; E546N222; E545N223; E543N223	26
Pirin	E542N215; E542N216; E542N217; E542N218; E543N215; E543N216; E543N217; E544N215; E544N216; E544N217	10
Rhodops	E546N217; E547N222; E548N219; E552N218; E552N220; E556N220; E545N218; E545N219; E546N219; E546N220; E547N217; E547N220; E547N218; E547N219; E547N221; E548N217; E548N218; E548N220; E548N221; E549N216; E549N217; E549N218; E549N219; E549N220; E549N221; E550N216; E550N217; E550N218; E550N219; E550N220; E550N221; E551N216; E551N217; E551N218; E551N219; E551N220; E551N221; E552N216; E552N217; E552N219; E552N221; E553N216; E553N220; E554N220; E556N218; E553N217; E553N218;E553N219; E553N221; E554N215; E554N216; E554N217; E554N218; E554N219; E554N221; E555N215; E555N216; E555N217; E555N218; E555N219; E555N220; E555N221; E556N216; E556N217; E556N219; E545N220	60
Middle Balkan	E555N229; E551N230; E547N229; E549N229; E549N230; E556N231; E557N230; E558N231; E548N229; E548N230; E549N231; E550N229; E550N230; E551N229; E552N229; E552N230; E553N229; E553N230; E554N229; E554N230; E554N231; E555N230; E555N231;E556N230; E557N231	25
Kotlen mountain	E564N233;E564N234;E565N234; E566N234	4

CORINE Land Cover (CLC)

- CORINE Land Cover (CLC) is one of the most well-known and used products from the Copernicus Land Monitoring Service.
- It has previously been produced in 1990, 2000, 2006 and 2012 and now the 2018 edition is available.
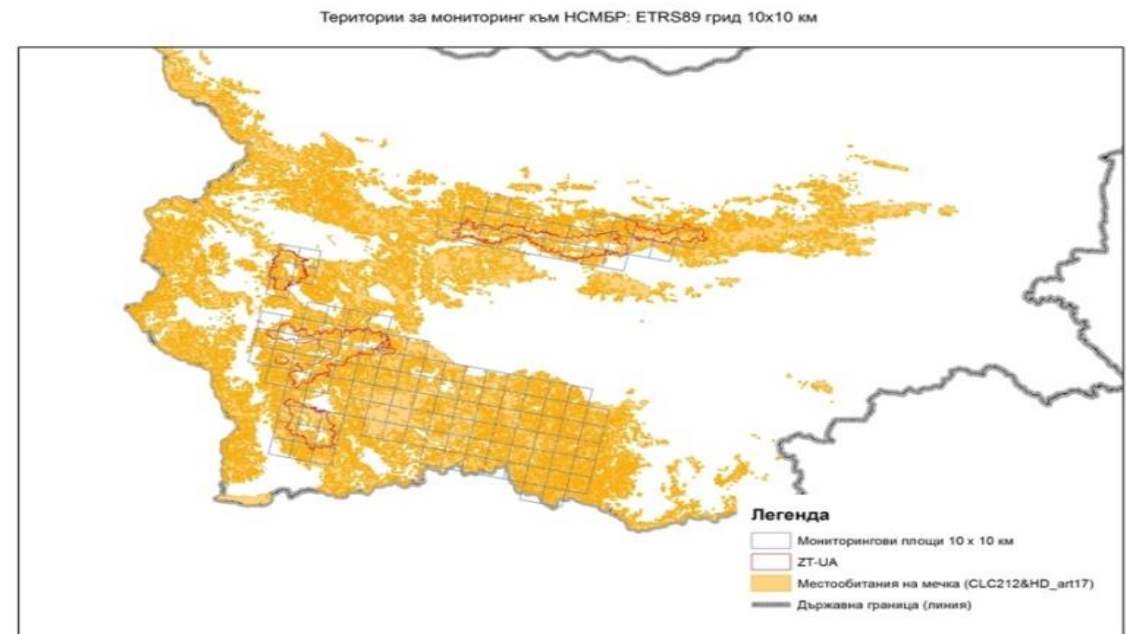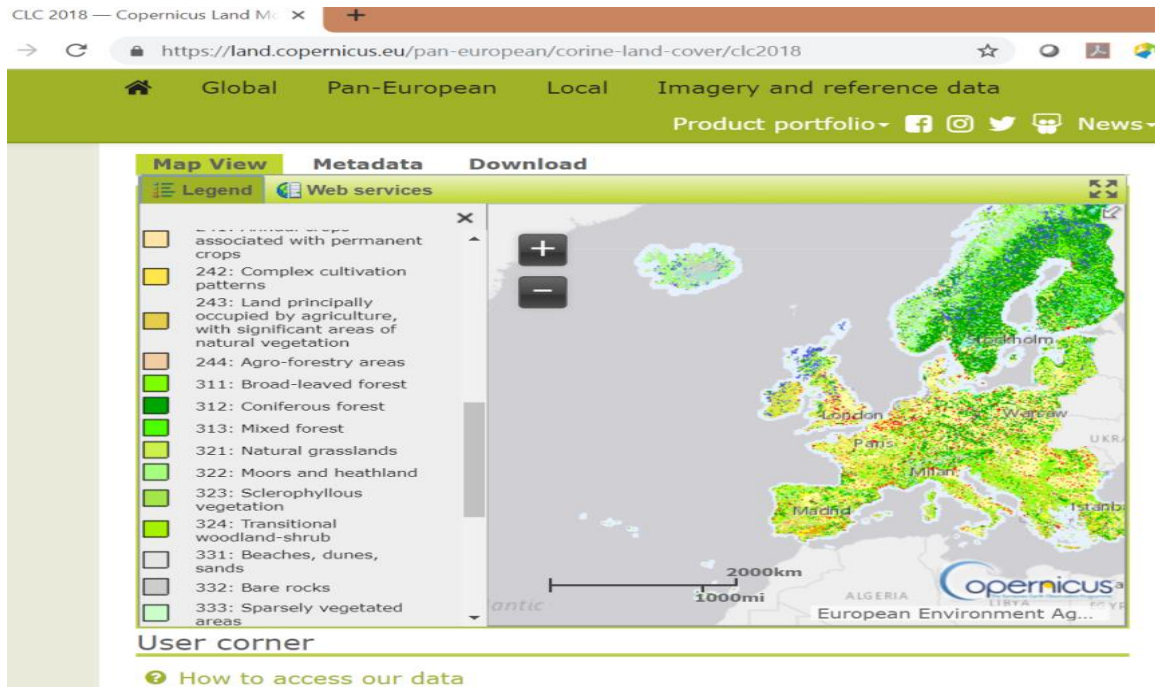
Transect method

It is based on the collection of brown bear sign on predefined set of routes (transects) and the determination of the unique traces (especially footprints).

Statistical estimates for population size of the brown bears using data of national monitoring and developed HPDA service.
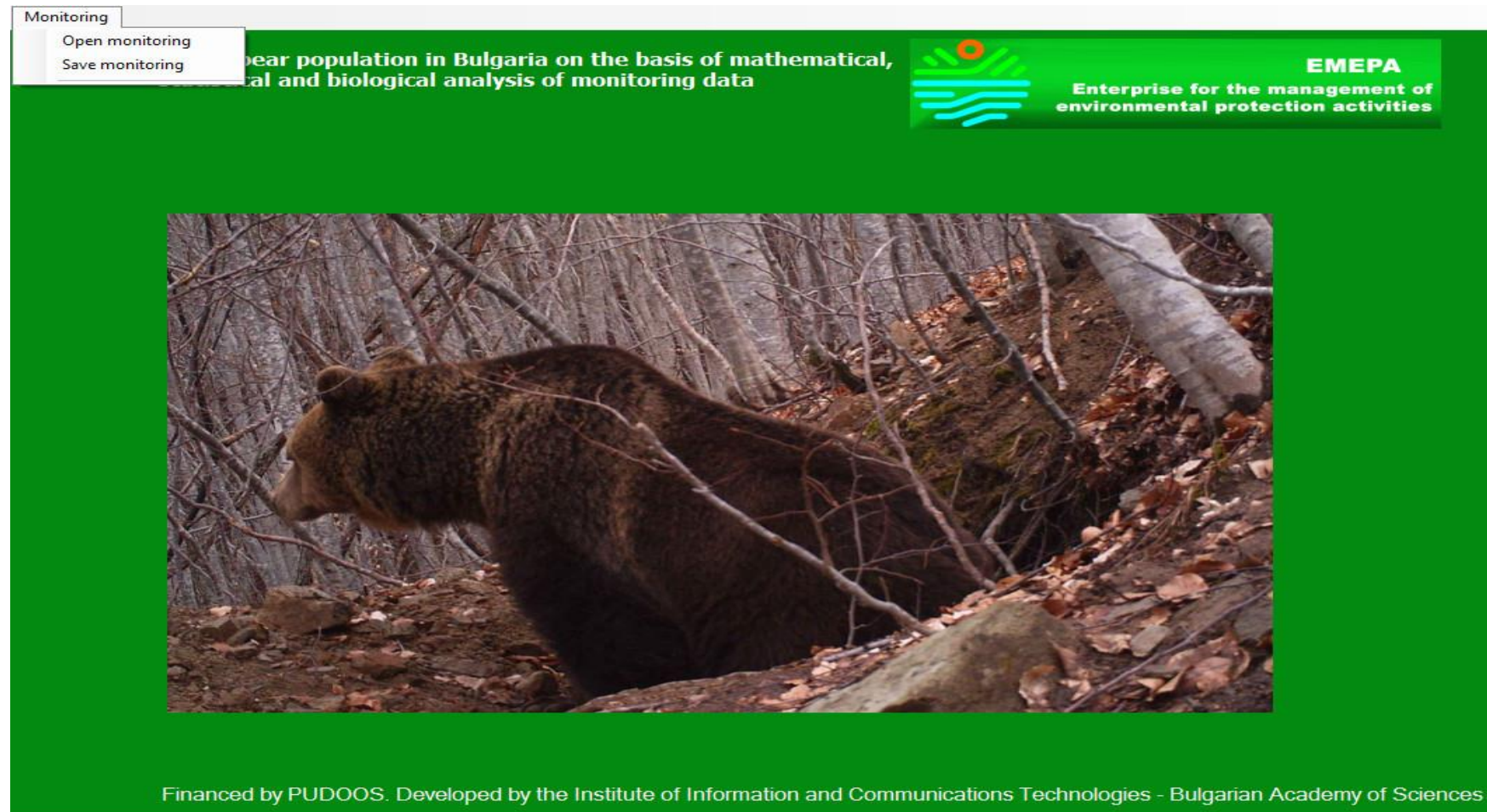
- **Type of the forests:**
  - **Deciduous forests** — **311**
  - **Coniferous forests** — **312**
  - **Mixed forests** — **313**
  - **Vegetable communities of shrubs and grasses** — **322**
  - **Transitional a wood bush** — **324**
  - **Other land cover** — **no code**
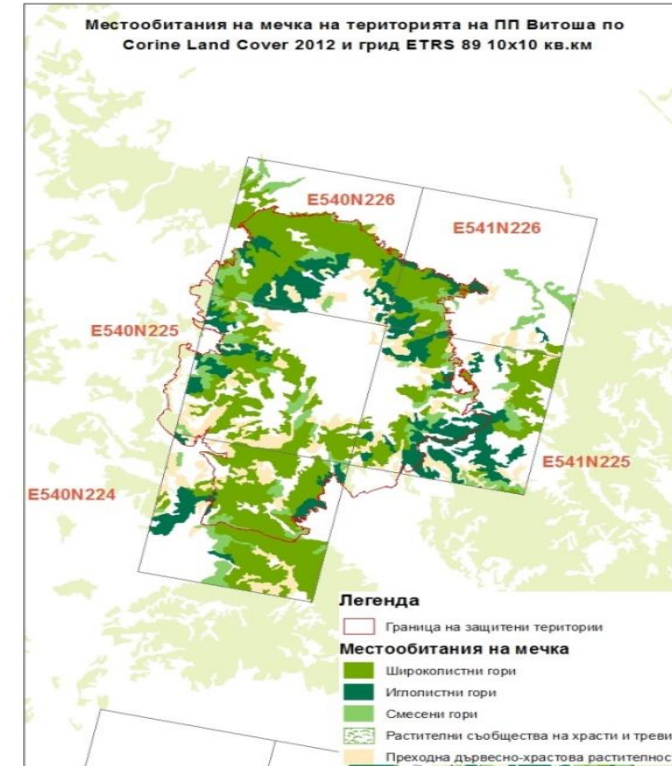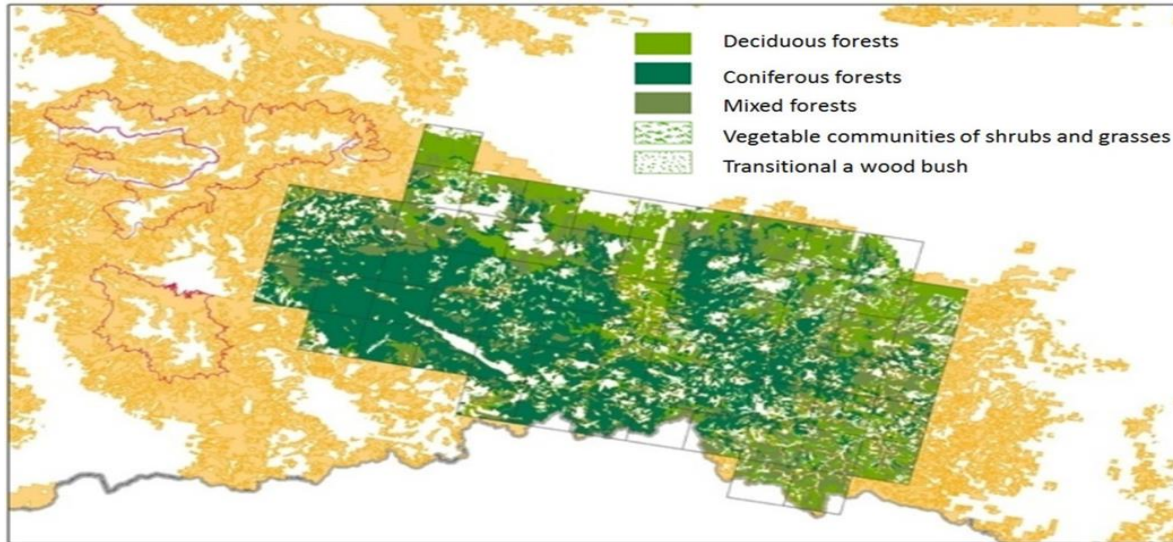
Bears' habitat for monitoring in the Western Rhodopes and Vitosha mounting

Start of the HPDA service

- Input the monitoring data to start the preproduction process

Estimation of the population size of the brown bears (1/2)

The evaluation is done in two steps.

First step: Identify unique traces based on collected observations in the national monitoring. The number of unique traces is determined by experts using the developed software product. Once the unique number of traces has been obtained, the program automatically allocates them by number in the respective 5 types of forest and in the residual area.
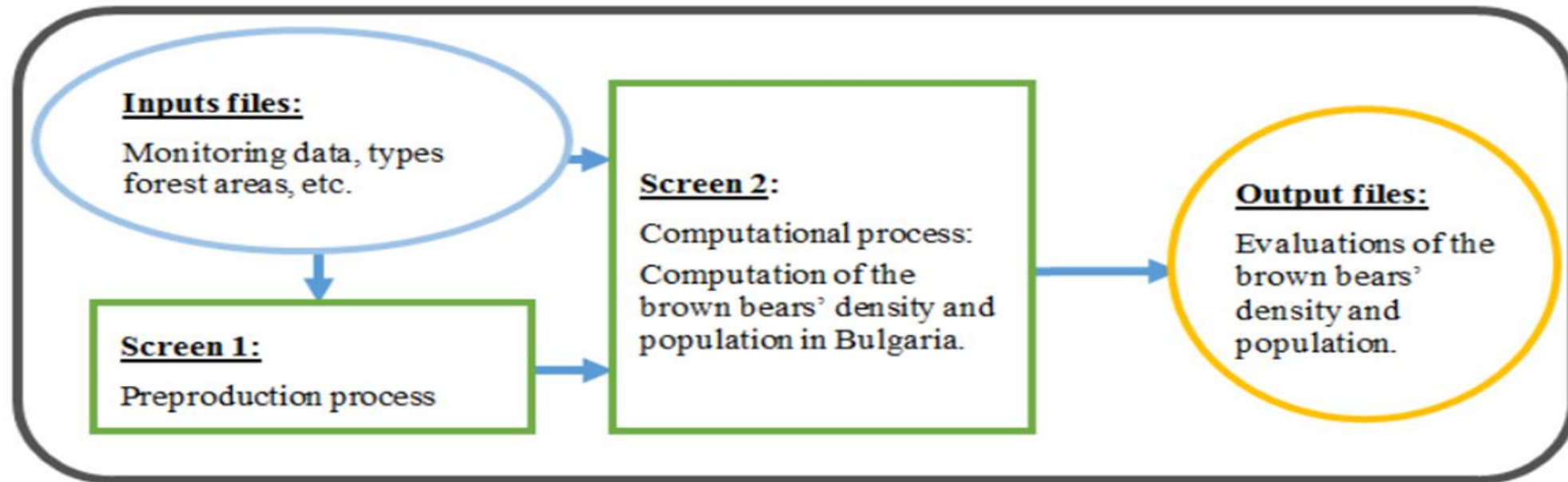
Preproduction process: Define the unique traces

Compute distances and show traces on the Gmap

Skipping, re-coloring and re-counting

Computational process

- Computation of the density and the population of the species

New feature – age structures by unique traces

New feature – age structures of the estimated population

New feature – Calculate with threats

Reference values

Estimate of brown bear population in Bulgaria on the basis of mathematical, statistical and biological analysis of monitoring data

Executive Environment Agency
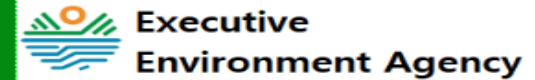
Bears | **Results**

Open areas	Save areas		Load areas

ETRS	visited	Mountain	Number of traces
E543N216	no	Pirin	not visited
E543N217	yes	Pirin	1
E543N219	yes	Rila	1
E543N220	yes	Rila	3
E543N221	yes	Rila	1
E543N222	yes	Rila	1
E543N223	no	Rila	not visited
E544N215	no	Pirin	not visited

Accuracy 10000 | All | monitoring-2017 | Calculate | Save Calculation

Mountain	Estimate	Lower boundary	Upper boundary	Threat Level
Stara Planina	72.99	49.64	96.34	Unfavorable-bad
Western Rhodopes	209.8	169.33	250.28	Favorable
Rila	69.89	58.12	81.67	Favorable
Piril	35.46	31.34	39.58	Unsatisfactory
Vitosha	23.06	23.06	23.06	Unsatisfactory
Kotlenska Planina	8.75	7.52	9.99	Favorable
Verila	13.13	12.41	13.86	Unsatisfactory
Plana	6.28	6.28	6.28	Favorable
Alpine region	385.43	316.4	454.46	Favorable

Show age structure	Age structure by marks	Calculate with threats	Reference values

Reference values for the main local populations of the brown bear

Level: / Brown bear habitat	Favorable	Unfavorable - unsatisfactory	Unfavorable - bad	Large population of brown bear
Population of the brown bear in the sample areas on the territory of Bulgaria	420 – 690	370-419	Under 370	Over 691
Central Balkan	130 – 180	80 – 129	Under 80	Over 181
Western Rhodopes	140 – 220	120 – 139	Under 120	Over 221
Rila	70 – 125	48 – 69	Under 48	Over 126
Pirin	40 – 95	30 – 39	Under 30	Over 96
Vitosha	9 – 13	6 – 9	Under 6	Over 14
Plana	4 – 6	2 – 3	Under 2	Over 7
Verila	5 – 8	2 – 4	Under 2	Over 9
Kotlen mountain	7 – 10	3 – 6	Under 3	Over 11
Alpine biogeographical region	397-650	353-397	Under 353	Over 651
Continental biogeographical region	23 – 40	15 – 22	Under 15	Over 41

Financed by PUDOOS. Developed by the Institute of Information and Communications Technologies - Bulgarian Academy of Sciences

Results from monitoring - 2017

Mountain	Evaluation	Lower boundary	Upper boundary	Level
Balkan mountains	61	44.8	76.19	Unfavorable - bad
Western Rhodopes	200	161.7	238.85	Favorable
Rila	70	56.61	83.44	Favorable
Pirin	37	31.29	42.92	Unfavorable - unsatisfactory
Kotlen mountain	6	5.35	7.72	Favorable
Plana, Verila, Vitosha	27	25.26	27.93	Favorable
Alpine area	368	305.26	426.85	Favorable
Continental area	33	31.53	33.98	Unfavorable - bad
Total	401	338.24	459.83	Unfavorable - unsatisfactory

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Results from monitoring - 2018

Mountain	Evaluation	Lower boundary	Upper boundary	Level
Balkan mountains	61	47.75	74.82	Unfavorable - bad
Western Rhodopes	185	159.46	210.78	Favorable
Rila	84	68.15	100.42	Favorable
Pirin	40	28.88	50.38	Favorable
Kotlen mountain	2	1.21	2.76	Unfavorable - bad
Plana, Verila, Vitosha	2	1,71	3.15	Unfavorable - bad
Alpine area	369	320.39	416.69	Favorable
Continental area	5	2.92	6,13	Unfavorable - bad
Total	374	320.39	416.69	Unfavorable -unsatisfactory

Results from monitoring - 2019

Mountain	Evaluation	Lower boundary	Upper boundary	Level
Balkan mountains	58	47.18	67.21	Unfavorable - bad
Western Rhodopes	185	154.94	214.5	Favorable
Rila	59	48.42	69.94	Unfavorable - unsatisfactory
Pirin	41	31.36	50.86	Favorable
Kotlen mountain	8	7.33	8.72	Favorable
Plana, Verila, Vitosha	46	44.27	47.53	Favorable
Alpine area	339	287.14	388.26	Unfavorable - unsatisfactory
Continental area	58	54.57	59.73	Unfavorable - unsatisfactory
Total	397	344.71	445.83	Unfavorable - unsatisfactory

Results from monitoring - 2020

Mountain	Evaluation	Lower boundary	Upper boundary	Level
Balkan mountains	77	54.34	100.22	Unfavorable - bad
Western Rhodopes	229	171.91	286.3	Unfavorable - unsatisfactory
Rila	93	71.86	114.26	Favorable
Pirin	35	29.07	40.83	Unfavorable - unsatisfactory
Kotlen mountain	5	3.53	5.99	Unfavorable - unsatisfactory
Plana, Verila, Vitosha	18	16.99	18.90	Favorable
Alpine area	438	341.45	532.5	Favorable
Continental area	19	19.19	19.19	Unfavorable - bad
Total	457	360.64	551.69	Favorable

-	2017	2018	2019	2020
estimate bear population	401	374	397	457

ЗАКЛЮЧЕНИЕ

Тази услуга беше създадена за нуждите на **ИЗПЪЛНИТЕЛНА АГЕНЦИЯ ПО ОКОЛНА СРЕДА**(ИАОС), КОЯТО Е КЪМ МИНИСТРЕРСТВОТО НА ОКОЛНАТА СРЕДА И ВОДИТЕ (МОСВ) С ФИНАНСОВАТА ПОДКРЕПА НА **ПРЕДПРИЯТИЕ ЗА УПРАВЛЕНИЕ НА ДЕЙНОСТИТЕ ПО ОПАЗВАНЕ НА ОКОЛНАТА СРЕДА** (ПУДООС).

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Thank you!

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