

JENNIFER HATLAUF & KLAUS HACKLÄNDER, Wien

## Preliminary results for golden jackal (*Canis aureus*) survey in Austria

Key words: Goldschakal, golden jackal, *Canis aureus*, Monitoring, bioacoustic survey

### 1. Introduction

The known historic range of the golden jackal (*Canis aureus*, L. 1758) included large parts of Eurasia and Africa, but this was recently reconsidered. Results of new genetic studies suggest that the African golden jackals (*Canis anthus*, F. Cuvier 1820) should merit recognition as a full, separate species (RUENESS et al. 2011; GAUBERT et al. 2012; KOEPFLI et al. 2015). Therefore, Central and South-East Europe hold an important role in the golden jackal species conservation and management, as the main populations of the European jackal, also called Caucasian jackal (*Canis aureus moreoticus*, I. Geoffroy Saint-Hilaire, 1835) are especially known to be in Bulgaria, Greece, Serbia, Croatia, Hungary and Romania (HATLAUF et al., 2016a; ARNOLD et al., 2012; KRYŠTUFEK et al., 1997). Thus, in new colonisation areas, far outside known historical range like in regions of the Baltic countries, Poland, Germany, Denmark or the Netherlands the golden jackal is one of the least known mammals. Its main habitat was traditionally located in the southeast of Europe (ARNOLD et al., 2012; KROFEL, 2008), but since the 1950's it began to expand this range with reported sightings from as far west as Switzerland and as far north as Estonia. Still, very little is known about the jackal's distribution patterns or the factors for this expansion.

The European Habitats Directive lists the golden jackal as a 'species of Community interest' in

Annex V as well as for example the pine marten (*Martes martes*), European polecat (*Mustela putorius*) or chamois (*Rupicapra rupicapra*). The conservation status of all species of Community interest needs to be monitored before any management measures, like hunting, can be applied (TROUWBORST et al., 2015).

How will golden jackals influence native biodiversity in new areas where future reproductive groups and new population clusters may occur? Are precautions necessary or will it be a positive addition to the existing ecological system? Many questions arise and probably a very important one will be: How can any decision be made, if neither occurrence is confirmed nor relevant biological or ecological data is yet available for the area in question? Austria will face some of these questions in the future concerning the autochthonous golden jackal, which found its way here by foot. We initiated this study to start gathering important data – distribution data on the golden jackal in Austria.

The first reproduction was located in southeast Austria, the national park lake Neusiedl in 2007 (HERZIG-STRASCHIL, 2008) and again in 2009 (WABA, pers. comm.) – since then no proof of territorial groups was recorded. Every once in a while a presumable vagrant got reported as roadkill or appeared on a photo trap picture. Assumed knowledge of occurrence in some states is not yet based on scientific evidence. Nevertheless, the decision to list the jackal as hunted species with an open season has been made in

upper Austria; in other states the position varies between strictly protected or huntable with closed season (HATLAUF et al., 2016b).

In Austria's neighbouring country, Hungary, the golden jackal population grew rapidly from first recorded individuals in the 1990s (after its Europe-wide extinction in the middle of the 20<sup>th</sup> century) (SZABÓ et al., 2007) to over 2500 shot specimen (hunting bag data from [www.oiva.info.hu](http://www.oiva.info.hu)) and an estimated population size of over 7.000 individuals in the year 2013 (HELTAI et al. 2013) – about 20 years later. So far this rapid population growth did not happen in Austria.

Still, the need for regular surveys is evident and we

- present the first semi-systematic fieldwork to gather information about the golden jackal based on previous opportunistic records and
- try to establish a basis for future monitoring standards.

## 2. Material and Methods

The survey of an elusive and mostly scattered living species, like the golden jackal, can be challenging. Direct counting methods of individuals are not possible, except in areas with

highest densities, like for example on the Croatian Peninsula Pelješac (KROFEL, 2007). Further, indirect methods, like searching for scat or tracks bear uncertainties, because of the risk of confusion with other canids, like fox (*Vulpes vulpes*) (REINHARDT et al., 2015) or dog (*Canis familiaris*).

One indirect and non-invasive method – the bioacoustic stimulation – is used successfully in golden jackal research (GIANNATOS et al., 2005; SZABÓ et al. 2009; KROFEL, 2009; BANEJA et al., 2012), since their howling is usually distinguishable from other canids. Acoustic stimulation can help to detect territorial groups; single, vagrant individuals are less likely to answer. Furthermore, response rates in areas with low densities, like in Austria, are usually lower, than in areas with high densities (GIANNATOS, 2004; KROFEL, 2008). The combination with other research methods like photo trapping and analysis of roadkill will therefore prove to be important to monitor future dispersal and expansion closely. To gather more information on the origin of the animals, monitoring-activities may also include non-invasive genetics, like scat or hair analysis (KELLY et al., 2012) – these will be utilised in the future. The following monitoring approaches were implemented so far (Figure 1).

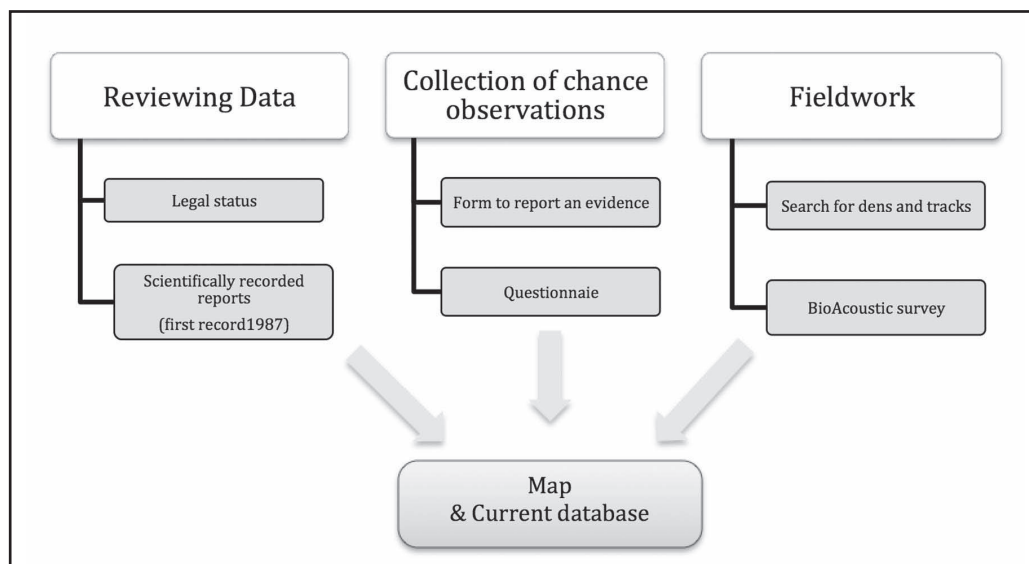


Fig. 1 Combined monitoring efforts

### 2.1. Reviewing data

- Publications of scientifically recorded reports since 1987 were analysed, considering HOI-LEITNER & KRAUS (1989), ZEDROSSER (1995), HUMER (2006), PLASS (2007), HERZIG-STRASCHIL (2007) and DUSCHER (pers. comm.). Further we assigned categories of quality (C1-C3) for a clear discrimination and assessment of evidence for new records from 2015 and 2016.
  - C1 – strong evidence with proof (for example: dead animal – shot or roadkilled, good picture verified by experts; genetic verification)
  - C2 – verified evidence with proof (for example: tracks or scat examined by an expert or sighting and vocalisation confirmed by an expert)
  - C3 – unconfirmed evidence (for example: sightings and howling without proof, picture with bad quality) (modified from HATLAUF et al., 2016a).

### 2.2. Data collection, evaluation and documentation – Assessment of opportunistic records

- Collection of chance observations reported by local forestry or hunting association: Dead specimen, observations, photo trap pictures or other evidence could be reported with an online form (see appendix) available for download. Data is recorded similar to recommendations for documentation of large carnivores (KACZENSKY et al., 2009).
- Collection of observations by means of a questionnaire:  
An online questionnaire (questions adapted from HUMER, 2006) was launched on March 1<sup>st</sup> 2016 and sent to gamekeepers through the email distribution of different hunting associations, with approximately 2000 possible participants - mainly to acquire new records but also to take human-dimensions concerning the potential golden jackal colonisation of Austria into account. The questionnaire was additionally posted in several hunting- and non-hunting related Facebook groups/analysis will be presented in future work. The questionnaire will still be available until

the end of the year and the dispersion process is not yet finished. 11 main questions were asked, with detailed additional queries.

### 2.3. Fieldwork – Bioacoustic surveys close to reported evidence

Specific calling stations were selected within the proximity of previously reported records (also close to the confirmed reproduction-site in 2007) and in suitable habitat. The bioacoustic stimulations were performed in December 2015 and February 2016 at 64 calling stations in five different survey areas and started approximately one hour after sunset.

The distance between calling stations was defined with 2 to 4 km, depending on the terrain and accessibility (GIANNATOS et al., 2005). Some of the calling stations were deliberately selected in a wetland area, which show high habitat suitability in an Austrian-wide golden jackal GIS model (HATLAUF, 2015) but did not affirm previous golden jackal reports of any kind. The playback (original recording by L. Szabó) was played from SD card with a “PYLE PMP57LIA” 50 watt megaphone. Using a megaphone allowed the coverage of a 360° radius at every calling station through changing direction after every playback. On average the survey lasted 20 minutes at each calling station. The survey was performed in nights with clear sky and still air or just a slight breeze; on two occasions the wind was very intense and one time the sessions had to be aborted because of sudden rain and severe storm.

To minimise bias as far as possible and utilize standardised assessment of golden jackal answers, the following categories were assigned for this survey (HATLAUF et al. 2016a):

- 1) The typical high-pitched “yip-howls” from golden jackals are rated as strong evidence – BAM (BioAcoustic Monitoring) C1, because of its distinctiveness to other species.
- 2) It may also occur that single individuals respond to the playback; for example 38 % in a study in Croatia (KROFEL, 2008) and 43 % single jackals in areas in Italy (COMAZZI et al., 2016). It was observed, that these individuals sometimes answer as representa-

tives for the whole group (KROFEL, pers. comm.); in this survey it is described as a more uncertain category – BAM C2.

3) If another species answers, or no jackal responds to the playback the category is entitled as “no response” – BAM NR.

All responses were recorded with “handy recorder” and microphone “ZOOM H1”. It provided sufficient quality of recordings in order to re-listening to questionable responses for affirmation.

*Table 1 Description of categories for assessing responses of golden jackals through bioacoustic survey.*

Category	Description
BAM C1	Strong evidence (typical yip-howl sequences)
BAM C2	Equivocal or doubt (only one animal, barking or without yip-howl)
BAM NR	Another species or <b>no response</b> , this situation requires further studies

## 2.4. Fieldwork – Photo trapping

- In December a local hunter placed two photo traps within his hunting terrain at two bait places in Burgenland (a region with previous photo trap pictures). These traps have been active for three months (31. December 2015 to 31. March 2016).
- In January 2015 four photo traps were placed in another area in Burgenland (with previous evidence of one shot animal and one sighting) at a bait place.  
These four photo traps have been active between 15. January 2016 and 31. March 2016. In both areas the local hunters maintain the photo traps regularly.

## 3. Preliminary Results

### 3.1. Dead specimen & Photo trap pictures

Since the beginning of the project in October 2015, two reports of golden jackals, both male, killed on roads reached our knowledge. The bodies are preserved for further analysis and

tissue samples for genetic analysis are saved. The photo traps did not provide any golden jackal pictures yet.

### 3.2. Questionnaire

Accumulated in one month, the questionnaire provided 64 answers. No reports of observations or spontaneous howling were reported, but **two new photo trap pictures** were sent through the questionnaire. Further it was possible to get intermediate results regarding knowledge about golden jackals and desired monitoring options.

*Short statistic summary for the human-dimension part of the questionnaire:*

- 64 responses altogether
- 40 males/24 women
- 32 hunters/32 non-hunters
- 48 (75 %) want to learn more about golden jackals in Austria and to receive further information

An extract of responses is presented as followed. Most participants fully or mostly agree, that the golden jackal constitutes enrichment to biodiversity and a fascination for humans. Considering the jackals' presence in hunting grounds, participants vary in their opinion (figures 2 and 3). Almost half the participants would like to see the golden jackal listed as a huntable species if the population is in a stable situation, whereas the other half would like to see it protected in Austria. A more differentiated graph of hunter's opinion versus non-hunters opinion is given in figure 4.

Another question dealt with different options for management; the highest percentages are summarised (figure 5):

- A nationwide management plan is desired – 77 % regard this as very important, 19 % as important;
- 71 % think, that information and experience from other European countries is very important, 27 % see this as important;
- 78 % believe, that receiving information about life and behaviour of golden jackals is very important, 18 % see it as important.
- 71 % consider constant data collection very important, 26 % assume it as important.

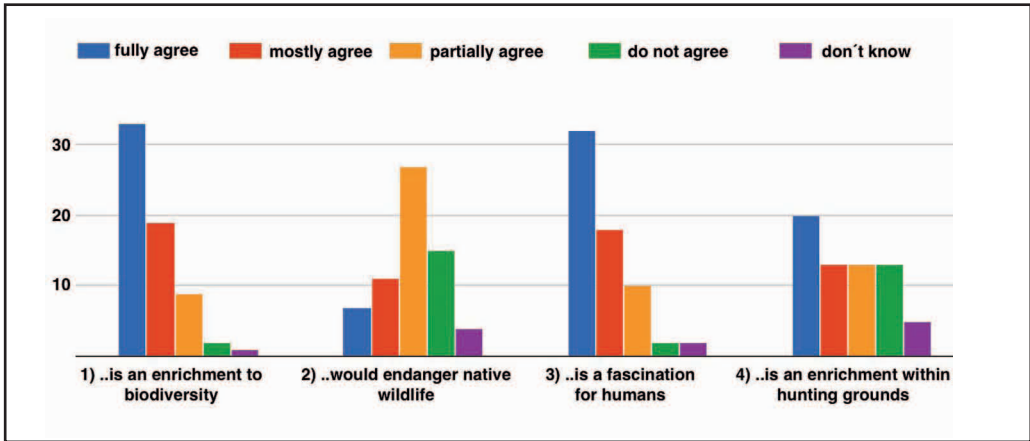


Fig. 2 Opinion of participants concerning the place of the golden jackal within Austrian biodiversity

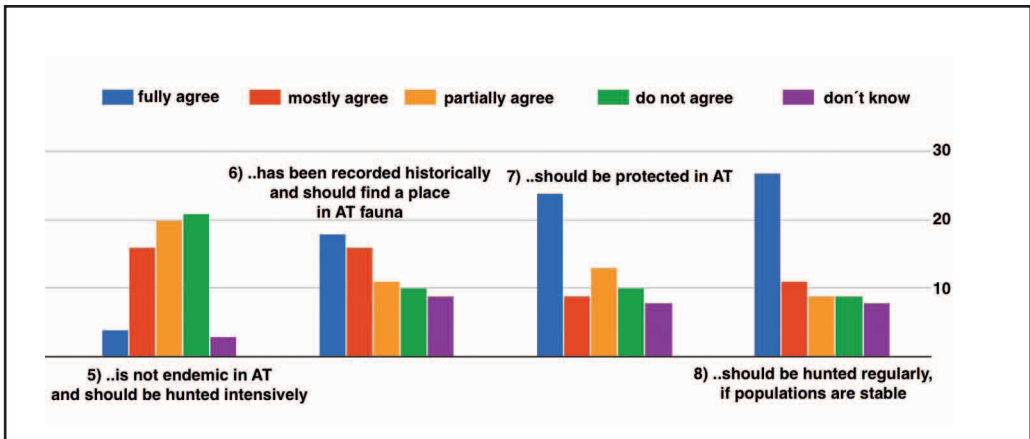


Fig. 3 Opinion of participants concerning the place of the golden jackal within Austrian biodiversity (part 2)

### 3.3. Bioacoustic stimulation

This survey resulted in five indistinct answers (BAM C2) from single individuals or during unexpected windy situations and one clear answer (BAM C1) – see figure 6. Three of the BAM C2 answers lacked the typical yip-howl and two **BAM C2** occurred under very windy situations; the assessment on-site was not possible as the scientists, that were present could neither explicitly confirm a golden jackal response nor exclude the possibility.

At three different points, foxes (*Vulpes vulpes*) were heard exactly after the playback and in sections near villages, dog barking could be detected; one beech marten (*Martes foina*) curiously approached a calling station and one fox sighting occurred. The **BAM C1** was a typical yip-howl answer and came from a group of 2–3 jackals. As chorus howling indicates the presence of a reproductive family group (LAPINI et al., 2009), this was the first strong evidence for reproduction in Austria by the means of bioacoustic stimulation.

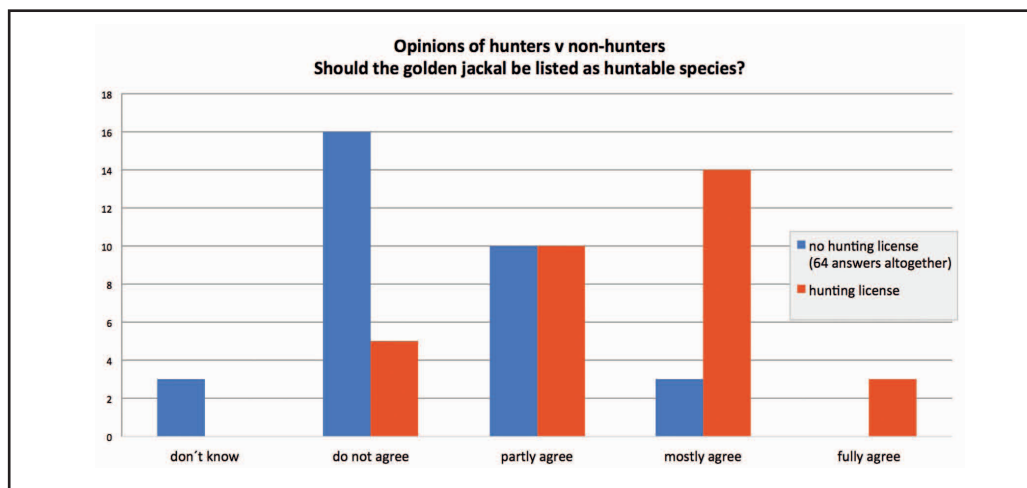


Fig. 4 Opinion of participants on listing the golden jackal as huntable or not - with special regard to ownership of hunting licence

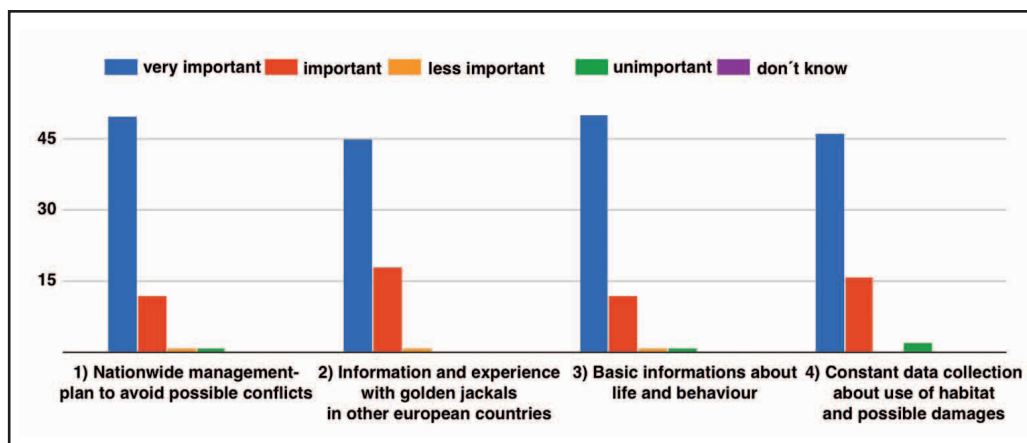


Fig. 5 Answers to the question "What kind of management strategies do you believe useful in Austria?"

### Additional information on other species:

- In two national parks several other species near the calling stations were documented during fieldwork: grey heron (*Ardea cinerea*), tawny owl (*Strix aluco*), mallard (*Anas platyrhynchos*), grey goose (*Anser anser*), great cormorant (*halacrocorax carbo*) and rails (*Rallidae*) responded immediately after the playback.
- In a big water protection area Eurasian coot (*Fulica atra*), northern lapwing (*Vanellus vanellus*), common pheasant (*Phasianus colchicus*), Eurasian teal (*Anas crecca*) and

long-eared owl (*Asio otus*) affirmed by accompanying ornithologist could be heard, but not in accordance or as specific reactions to the playback; one time a cow immediately answered.

### Summary of new golden jackal evidence

- 1 BAM C1 answer during the bioacoustics survey in Burgenland, west of lake Neusiedl
- 2 C1 reported **roadkill**: one from Styria and one from Carinthia, approximately 50 km apart



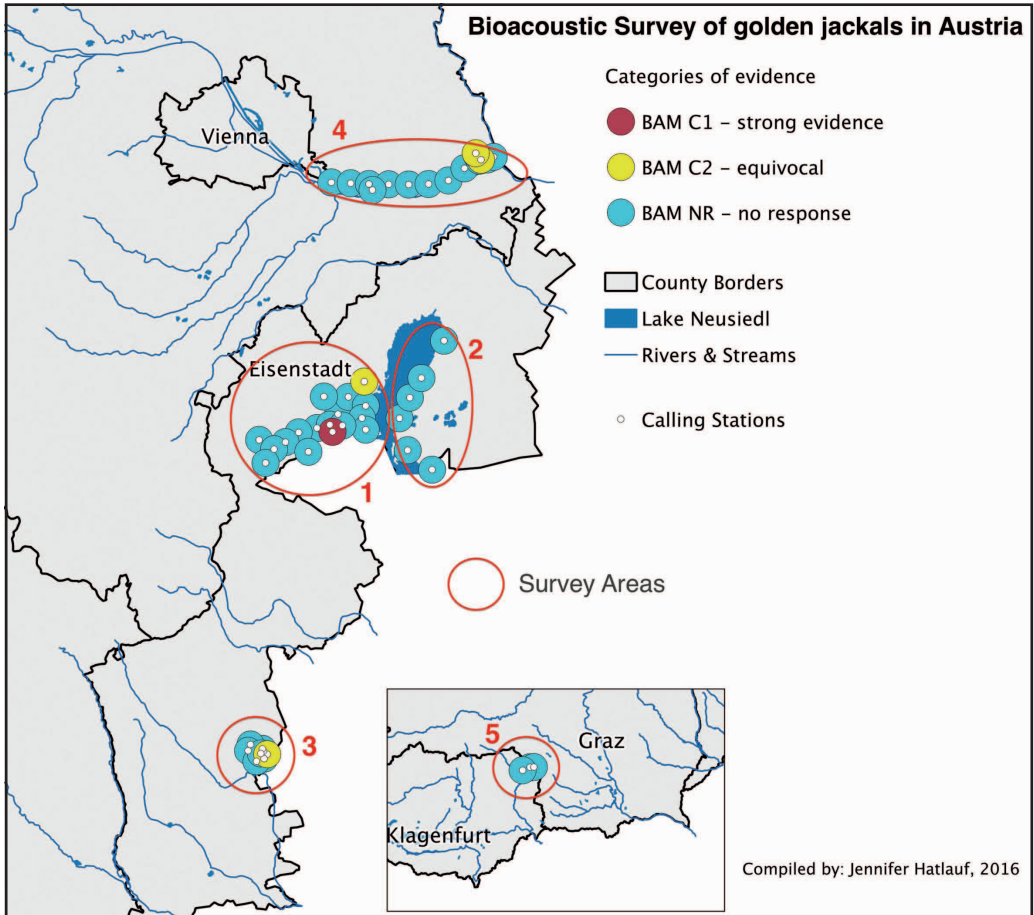


Fig. 6 Results for bioacoustic surveys from December 2015 and February 2016 with assigned categories BAM C1, BAM C2 and BAM Nr; Burgenland and lower Austria.

- 2 C1 **photo trap pictures**: one from Burgenland – in 20 km distance from recorded BAM C1 evidence (reported as response to the questionnaire) and one from across the Hungarian border, approximately 3 km to BAM C1 evidence
- 1 C2 **photo trap picture**: from Upper Austria (response to questionnaire)

### 3.4. Updated map

An up-to-date map, with a combination of previously recorded evidence since the 1990s and

records from this study was compiled and displays the golden jackal distribution in Austria, dated March 2016. Categories C1-C3 are utilized for the years 2015 and 2016. (figure 7)

## 4. Discussion

The results of the questionnaire can only present a very small insight to opinions and further analysis is needed after data collection is finished. At the moment the sample is still small, but first results may imply certain tendencies. Detailed future semiotic studies may

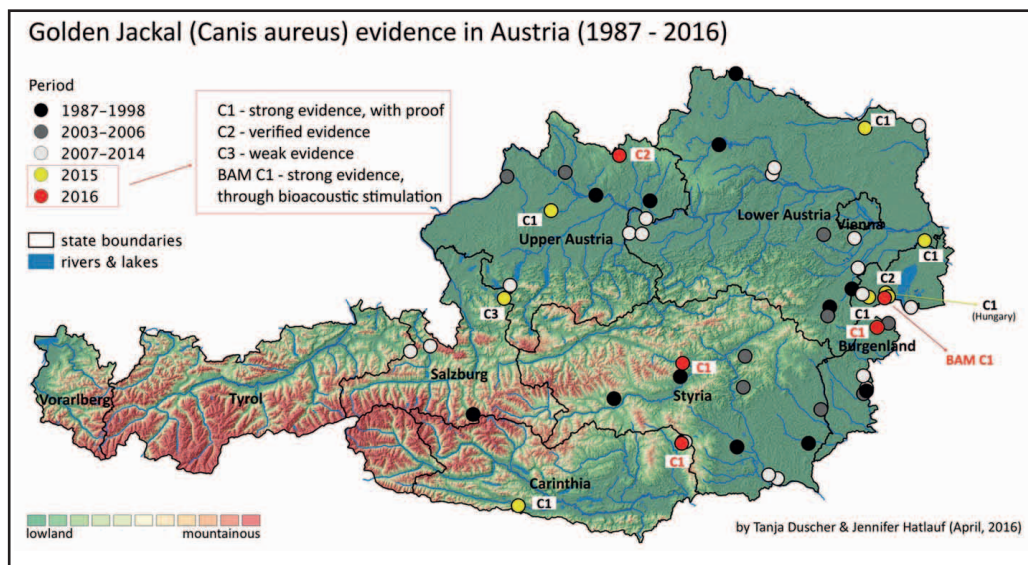


Fig. 7 Golden jackal evidence in Austria between 1987 and March 2016. Black and grey shaded points – records as far as 2014; yellow points represent evidence from 2015 and red dots show actual records from 2016.

proof helpful for conservation and management (MARAN, 2015).

Further, presented bioacoustic survey results can hardly be compared to results in countries with higher densities, for example to areas in Bulgaria, Croatia or Serbia (ŠÁLEK et al., 2013). In these regions the bioacoustic method was also used as a tool for comparing relative densities of regions and not only as simple determination of presence.

In areas where golden jackal colonisation is characterised by the establishing of new clusters and reproductive groups, the responsiveness ranges from 41 % like in Croatia (KROFEL, 2008), 50 % in Greece (GIANNATOS et al., 2005) to almost 60 % in Romania (BANEJA et al., 2012). During acoustic surveys in the Danube Delta a maximum of seven groups responded at one calling station, which added up to approximately 17 individuals per 10 km<sup>2</sup> (BANEJA et al., 2013). So far the highest densities of golden jackal occurrence was recently reported to be as high as 14,84 individuals per km<sup>2</sup>, determined with distance sampling method by Singh et al. (2016). When golden jackal presence is as scarce as in Austria, response rates to acoustic playback might as well be zero; in upper Soča

valley, Slovenia in a survey from 2011 – 42 calling stations provided no jackal response despite previous regular sightings, reported spontaneous howling, photo trap pictures and road-killed specimen in this area (MIHELIC & KROFEL, 2012). This may also be an example for the fact, that an absence of response cannot necessarily be interpreted as absence of jackals, but as possible absence of established territorial groups (GIANNATOS, 2004).

Still, as only one typical group-howl was recorded within 64 calling stations, it seems that the number of territorial golden jackals in surveyed areas is small.

Besides this, it is reported, that solitary individuals vocalise less frequently, than those who live in groups (GIANNATOS 2004), possibly due to their younger age or their attempt to avoid fights with a territorial group. A recent acoustic study by COMAZZI et al. (2016) resulted in 18 out of 42 (43 %) and another survey by KROFEL (2008) in eight out of 21 (38 %) responses by single individuals. If single individuals respond, the distinction to a dog's howl may be difficult and should be regarded as uncertain (LAPINI, pers. comm.); on the other hand single jackals can also show the typical yip-howling



sequence (KROFEL, pers. comm.) and be regarded as strong evidence. Single, but vagrant individuals are not likely to answer a playback of a group howling. If a single individual responds, it is assumed, that it is performed as representative for the whole territorial group (KROFEL, pers. comm.; HELTAI, pers. comm.).

Another factor needs to be taken into account – seasonality and difference in density may affect the responsiveness of golden jackals and can produce biased data (JAEGER, 1996).

In conclusion, as any methodology, the **bioacoustic stimulation** has its limitations and uncertainties, but provides most needed data on the possible distribution of golden jackals and is a very important tool. Considering the Habitats Directive requirements of monitoring *species of Community interest* that may be subject to management measures, acoustic stimulation and even more so – combined research methods will be essential for further studies.

## 5. Conclusion and further work

Within a relatively short period of time successful cooperations were formed, the questionnaire was launched and first calling stations were not only established but also provided first results. Newly identified records confirm, that both questionnaire and bioacoustic survey provided useful information to determine golden jackal distribution. We hope, this study marks the first step to future data collection and unified standards in Austria. In the future, the use of photo traps should be a bigger target and may be implemented additionally within the monitoring of other species.

Further project work will include detailed analysis of responses to the questionnaire and establishment of additional areas for the bioacoustic survey; moreover, the aim is to collect samples for genetic analysis. Besides this, investigation about basic differences between Hungarian and Austrian hunting regimes, habitats and culture will be targeted.

It is our goal to build an effective network and to ascertain fast assessment of records. It will show imperative to collect reports for future analysis; intensified studies and research is nec-

essary to further observe the dispersal of the golden jackal within Austria, and moreover in whole Central-, West- and North-Europe.

## 6. Thanks

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To all helping hands – Thank you!

## 7. Abstract

This article presents preliminary results from the first active monitoring attempt of golden jackals in Austria.

- 1) Chance observations were collected; an interactive form to report evidence is now available,
- 2) a short human-dimension questionnaire was launched
- 3) and bioacoustic surveys in preselected areas with altogether 64 calling stations were performed.

Two reports of jackal roadkill and additional two verified reports – photo trap pictures – were reported between January and April 2016. During the bioacoustic survey one territorial golden jackal group could be confirmed and five equivocal responses were recorded. As there was only

one typical group-howl response, it seems that the number of territorial jackals in studied areas is still small. Scientifically reported records between 1987 and 2012, records from 2012 to 2015 and results from this study were compiled and are presented in an up-to-date map. Further studies are needed in order to determine whether golden jackals have already established constant territories. Already selected areas should be monitored closely to observe future dispersal in Austria.

## Zusammenfassung

Dieser Artikel präsentiert die Zwischenergebnisse der ersten aktiven Überprüfung von Goldschakalanwesenheit in Österreich. 2007 gab es den ersten Nachweis von Reproduktion und 2009 einen weiteren. Seither wurden nur vereinzelte Zufallsmeldungen erfasst und eine systematische Überprüfung war bisher ausständig. In vorliegender Studie wurden:

- 1) Zufallsfunde gesammelt; ein interaktives Formular zur Meldung von Hinweisen zur Verfügung gestellt,
- 2) ein Fragebogen ausgesandt
- 3) und bioakustische Erhebungen in ausgewählten Arealen mit insgesamt 64 Rufstationen durchgeführt.

Zwei Berichte von überfahrenen Tieren und zwei bestätigte Fotofallen Bilder, die über den Fragebogen gemeldet wurden, konnten zwischen Januar und April 2016 aufgenommen werden. Die bioakustische Erhebung bestätigte eine territoriale Goldschakalgruppe; fünf weitere, aber nicht eindeutige Antworten konnten an den restlichen Rufstationen aufgezeichnet werden. Da die Erhebungen nur eine eindeutige Antwort ergaben, scheint die Zahl territorialer Goldschakale in den ausgewählten Untersuchungsgebieten klein zu sein.

Bisherige Nachweise aus den Jahren 1987 bis 2012, weitere Datensätze (2012 bis 2015) und die Ergebnisse aus vorliegender Studie wurden zusammengeführt und in einer aktuellen Karte dargestellt.

Weitere Studien sind erforderlich, um zu bestimmen, ob Goldschakale in anderen Gebieten bereits permanente Territorien etabliert haben.

Die bisher ausgewählten Areale sollten weiter studiert werden, um eine Ausbreitung des Goldschakals in Österreich zu beobachten.

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### Addresses of authors:

JENNIFER HATLAUF MSc.  
Univ.Prof. Dipl.-Biol. Dr.rer.nat. KLAUS HACKLÄNDER  
University of Natural Resources and Life Sciences, Vienna (BOKU),  
Institute of Wildlife Biology and Game Management (IWJ)  
Gregor-Mendel-Straße 33  
1180 Vienna, Austria  
E-Mail: hatlauf@hotmail.com

## Anhang

Report of golden jackal (*Canis aureus*) evidence

Date of evidence	Country
Exact Location (Latitude/Longitude if known)	Exact Location (name of nearest City)
Km to Nearest City	Sea Level

## Type of report

Dead Specimen (Roadkill)	Cameratrap
Dead Specimen (Shot/ or trapped)	Video
Track	Sighting/ how long:
Spontaneous howling	With spotting scope or binoculars

Proof of report	Yes	No
What kind?	Picture/Video	Scat
	Hair	gypsum impression
Number of Specimen	preserved specimen	organs/parts
Age and Gender of Specimen		

## Habitat in the area of proof

Forest (conifers)	Forest (broadleaf)	Forest (mixed)
Open Land (Greenland)	Near to perennial river	Wetland
Within settlement	Conservation area	Other:

## Personal details of correspondent

Name	
E-Mail	
Telephone	
Scientific Institute	
Internet Address (if already published)	
Are you a hunter?	Yes No

Commentaries (for example additional information)

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please send via e-mail

**Thank you very much for your report!**

Please send this report or questions to:

Jennifer Hatlauf, MSc.

University of Natural Resources and Life Sciences, Vienna

+43 650 500 2158

[hatlauf@hotmail.com](mailto:hatlauf@hotmail.com)