We disagree with Vilas and Paniagua's view that 'we are just beginning to understand the genetics of speciation'. We believe that the current abuse of the species concepts confuses the evolutionary biology debate and we want to clarify this confusion. There are three elements of concern regarding the species concept: (i) taxonomy; (ii) evolution; and (iii) biological diversity assessment. The species as a taxonomic unit is not a real problem as long as keys for species recognition are available to the public. Describing evolution and its mechanisms, or assessing biological diversity are rendered difficult by the use of any species concept. Applying a species concept within the context of evolutionary biology forces one to deal with the evolution of a fixed entity. The evaluation of biological diversity cannot be performed properly if any type of species concept is used. This was demonstrated with our bacteria and birds example in Ref. [1]. Alternative tools for evaluating biological diversity that could be generalized are being developed [2]. The *Escherichia coli* lineage provides one example that illustrates these problems. The name *E. coli* is used to describe commensal bacteria of humans that protect the digestive tract from other microbes, whereas the name *Shigella* spp. describes another group of bacteria that are deadly pathogens of humans. Physicians consider *E. coli* and *Shigella* spp. as two different genera because of the differences in their effects on human health. However, *Shigella* are actually forms of *E. coli* that recurrently appear by lateral transfers of genes between different *E. coli* strains [3]. Thus, the distinction between *E. coli* and *Shigella* is clinically useful, but it is not helpful in terms of evolutionary biology or biodiversity assessment.

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Letter

Immunodiagnostic approaches for detecting *Taenia solium*

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In a recent *Research Focus* [1], Ito and Craig stated that: 'the most reliable serology to detect cysticercosis in humans and animals is to analyze the antibody response against specific *T. solium* antigens'. The detection of circulating *Taenia solium* antigen, however, was given little attention in this article because of the problems associated with crossreactivity to other *Taenia* spp.

Antibody detection tests [e.g. enzyme-linked immunosorbent assay (ELISA) and enzyme-linked immunoelectrotransfer blot technique (EITB)] are the most appropriate tools for measuring exposure to *T. solium* in sero-epidemiological surveys and for confirmation of *T. solium* as the etiological agent of epilepsy. Conversely, antigen detection tests are more useful for other purposes such as the detection of active cysticercosis or the follow-up of NCC patients after treatment [2–5]. Although the available monoclonal antibody-based sandwich ELISAs for detecting circulating cysticercus antigen (Ag-ELISA) are not species-specific and can crossreact with *Taenia hydatigena* cysticerci in pigs, this should not jeopardize the diagnosis of human cysticercosis because *T. hydatigena* does not occur in humans.

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At least two Ag-ELISAs [6,7] have been validated under experimental and field conditions, and there are several advantages in using these Ag-ELISAs to diagnose human cysticercosis from serum samples. Ag-ELISAs only detect cases of active cysticercosis (i.e. the presence of living cysticerci) [3–5,8], which is important for deciding on the appropriate antiparasitic treatment (according to the guidelines proposed by Garcia *et al.* [9]). Patients with only calcified cysts, who do not need anthelmintic treatment, are consistently negative when tested by the Ag-ELISA [8]; this has also been confirmed in a pig model infected with only calcified cysts [10]. When identifying *T. solium* as the etiological agent of epilepsy, antibody detection is more appropriate than Ag-ELISA because dead cysts are more-often responsible for epileptic seizures than those caused by living cysts [11].

The sensitivity of the Ag-ELISA is very high, even in light infections, for example, the Ag-ELISA can detect a single-cyst infection in a pig model [10]. The Ag-ELISA is very specific, and no cross-reactions were observed in sera from patients infected with other parasites, such as *Schistosoma*, hydatid cysts, *Ascaris*, *Trichuris*, filaria, *Entamoeba*, *Plasmodium* or *Trypanosoma* [3]. The Ag-ELISA is also an efficient tool for the follow-up of

NCC patients after treatment because circulating antigen disappears from the serum of cured patients within 1–3 months after treatment, which does not occur in patients who are not cured [8,12].

In sero-epidemiological studies, antibody detection tends to overestimate the prevalence of cysticercosis because antibodies are no longer detected in serum within 1–3 years in 30–40% of patients sero-positive for *T. solium* in endemic countries [13]. This reflects a transient antibody reaction in patients after exposure to *T. solium* eggs or is a result of self-cure by the patient [13].

In conclusion, the application of antibody or antigen detection depends on the information that is needed. Ideally, a combination of both tests is best for sero-epidemiological studies and for supporting diagnosis by neuro-imaging techniques.

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Letter Response

Response to Dorny *et al.*: Immunodiagnostic approaches for detecting *Taenia solium*

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There are two main strategies for the serodiagnosis of cysticercosis, as explained by P. Dorny *et al.* In our *Research Focus* [1], we focused on the use of antibody-detection methods because there are more biochemical and molecular data on the candidate antigens for detecting specific antibody responses to *Taenia solium* than there are on the circulating antigens that can be detected by monoclonal antibodies (mAb) (see references in Ref. [1]). In addition, a commentary on detection assays based on the circulating antigens of *T. solium* would have required a longer article than our *Research Focus*.

The major components of the *T. solium* metacestode glycoproteins (GP) are now well-recognized as hydrophobic ligand-binding proteins (HLBP) [2]. To date, these glycoproteins are the best candidate antigens for detecting specific antibody responses to *T. solium* in infected patients. Indeed, there is a positive correlation between human cases tested positive for *T. solium* antibodies and active neurocysticercosis cases (NCC), and between antibody-positive cases and the presence of subcutaneous nodules of viable *T. solium* metacestodes [3,4]. These correlations have also been confirmed by morphological and mitochondrial DNA analysis of resected subcutaneous nodules in Papua, Indonesia [4]. Hence, the most practical diagnosis of cysticercosis in remote areas (other than in India, where the majority of cysticercosis cases are caused by a solitary cyst) is the detection of subcutaneous nodules [4].

Antibody assays are suitable for detecting cases of active cysticercosis with or without a history of epilepsy. This is also supported by data obtained from tests involving blind controls in humans [4], pigs [5] and dogs [6]. Therefore, we believe that there is no evidence to suggest that the antigen-based enzyme-linked immunosorbent assay (Ag-ELISA) is better than the antibody-based ELISA (Ab-ELISA) for the detection of active cysticercosis. Molecular approaches and further research, in addition to phenotypic work on cysticercosis, should resolve this issue.

We agree that detection of circulating antigen could be appropriate for real-time monitoring of disease progression (particularly after curative treatment) because

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