Species Variation and Diversity

Polyclad flatworms resemble a taxon with an incredible diversity in tropical waters (Newman & Cannon, 1994; see section: Taxonomy). For quite a long time, the colour pattern of the splendidly coloured worms alone has been considered sufficient for their classification (Hyman, 1954, 1959). However, it has been shown that for identification of many species this is not enough for a reliable identification (Faubel, 1983, 1984). Field studies of Newman & Cannon (1994) revealed that very similar and almost identical colour pattern occur in different genera (*Pseudoceros - Pseudobiceros; Pseudoceros - Pseudoceros*) and even in different families (*Pseudocerotidae - Euryleptidae*) making a closer examination of subtle differences between species necessary. Comparative anatomy taking in account a suite of characters such as eye number and eye arrangement, form of pseudotentacles, pharynx, and especially analysis of the fine structure of the reproductive system has been proven to be an essential tool for species diagnosis of turbellarians (Newman & Cannon, 1994). Since the serial reconstruction of the male and female reproductive structures is difficult and makes special lab equipment necessary, it is reserved for specialists. Recently, molecular data (DNA sequencing) have been used to tell apart similar polyclad species (see section: Phylogeny). Without the employment of such tools, classification of polyclad flatworms can be erroneous in some cases. Specimen with similar colour pattern may resemble distinct species but may also belong to the same species featuring a genetically fixed colour and pattern variability (*modification*). On the other hand, specimen with an identical colouring may be members of different genera or even families. Therefore, if two polyclad specimen with similar colour pattern are to be compared, several possible scenarios are conceivable.

1.) The worms belong to different genera or even families, but a common selective pressure and the same environmental factors have been the evolutionary driving force for development of the same colour pattern. Expressed in phylogenetic terms: a similar set of colour-associated genes (= allels) or a distinct set of gene mutations have been favoured by selective pressure on the resulting phenotype. Such a sequence of events can be considered *analogous evolution*.

2.) In a second scenario, both worms share a common ancestor. Under the assumption that this ancestor already had reached an advantageous colouring, the colour pattern of both compared specimen can be very similar even if there may exist anatomical or other genetic differences. This is called *homologous evolution*.

3.) Evolution is an ongoing process and never stops! Random mutations in colour/pattern-associated genes, either in protein-coding regions or in their regulatory DNA sequences, together with the influence of environmental factors, such as light, temperature, and nourishment are driving forces that influence polyclad colour pattern. To say it sloppily, evolution is playing around with colours, to see if there is still a more effective colour for deterring putative predators (see sections: Mimicry and Predation and Defence). In phylogenetic time span, this may lead to a shift in the appearence of a species or to *speciation*, the emergence of a new species.

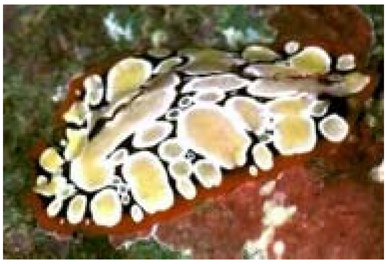
The following photo panels will show clearly how colour pattern between distinct species and among members of one single species may vary. Due to the lack of morphological and DNA sequence data of the depicted worms, it is actually unclear for which of the described scenarios the specimen stand for.

[*Pseudoceros dimidiatus*](#) von Graff, 1893 is a conspicuous and common pseudocerotid flatworm in tropical waters. It is encountered often during the day, moving over coral rubble. Its vibrant orange and yellow contrast to a pitch-black background colour and suggest that this polyclad is displaying [aposematic colouration](#) warning putative predators about its unpalatibility. As the combination of these colours is basically the same for all of the four worms, the two median yellow stripes that are separated by a thin black line, may vary from narrow to extremely wide. A high variability in the occurrence of numerous yellow transverse streaks varying in thickness and extension seems to be an additional hallmark of this species.




Yellow and black can be considered a very alarming and successful colour combination for deterring putative predators. It is found not only among pseudocerotid flatworms but also on salamanders, frogs, and arthropodes such as spiders and many insects (check out representative samples [here](#)). In most cases, this colour combination is associated with some sort of poison. This is an outstanding example for *analogous evolution* (e.g. unrelated species have developed the same striking features because of a similar selective pressure).

A similar variability is observed for [*Pseudoceros scintillatus*](#) Newman & Cannon, 1994. This pseudocerotid flatworm displays an even velvety black background combined with an orange marginal band and numerous large irregularly sized yellow-green maculae, each macula encircled by white, the typical color pattern of *P. scintillatus* (Newman & Cannon, 1994). However, a significant variability in size and extension of maculae can be observed. Maculae can vary from a single and separate arrangement (left photo) to a highly dense or even confluent pattern (photo at right). It remains to be shown, if all of the shown specimen are variants of *P. scintillatus* or if they resemble similiar but distinct species.

More undescribed pseudocerotid flatworms from South/East African waters with a remarkable *P. scintillatus*-like colour pattern. Nothing is known about the taxonomic and phylogenetic relationship of these worms. The two specimen at the right may be variants of *P. scintillatus* displaying whitish instead of yellow-green maculae.

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