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## 1 Neurotoxin stress-driven evolution in scallop genome

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9 Understanding the molecular mechanisms underlying the resistance of organisms  
10 to specific environmental stressor is fundamental to understanding the deepest  
11 relationships between evolution and adaptation. Among environmental stressors, the  
12 exposure to contaminants and/or toxins could positively select specific and efficient  
13 adaptations providing advantages for resisting and surviving<sup>1</sup>. Few organisms, such as  
14 filter-feeding bivalves, can tolerate and accumulate remarkably high amounts of  
15 potent natural neurotoxins such as paralytic shellfish toxins (PSTs, produced by marine  
16 dinoflagellates)<sup>2,3</sup>, although the specificity and molecular mechanism of this toxin  
17 resistance is not well apprehended.

18 Writting in *Nature communications*, Li et al. (2017)<sup>4</sup> recently take us an additional  
19 step forward in understanding adaptation and evolution processes, reporting how scallop  
20 genome evolution can be driven by environmental and ecological pressures (Fig. 1). Among  
21 all the investigations performed by the authors in this manuscript - comprising also  
22 impressive datasets on byssus, adductor muscle and sophisticated eyes evolution - specific  
23 attention has been provided to describing specific molecular mechanisms aim at  
24 handling PST production by blooming phytoplanktonic micro-algae. Indeed, this manuscript  
25 admirably shows that scallop uses its hepatopancreas to accumulate neurotoxins and its  
26 kidney to transform them into even more toxic forms through an expansion of  
27 sulfotransferases in the genome and the specific regulation of their expression  
28 processes, probably also as deterrence against predation, while it achieves  
29 neurotoxin resistance through point-mutations in sodium channels.

30 This research begs the questions of how environmental stressors are susceptible to  
31 select specific adaptative events from genome evolution? How resistance mechanisms  
32 are co-evolving with the development of toxic pressures, such as environmental  
33 toxin production? Indeed, the examples of the molecular adaptations managing  
34 specific ecotoxicological pressures remain critically rare<sup>1</sup>, and this manuscript push  
35 forward our understanding of how it may have emerged in the scallop genome.

36 To our knowledge, the original integrative approach developed by Li and co-workers,  
37 combining genomic, transcriptomic and ecotoxicologic investigations constitutes the first  
38 evidence of the effective influence of a natural ecotoxicological environmental stress (*i.e.*  
39 the proliferation of PST producing *Alexandrium minutum*) to the genome evolution (through  
40 the selection of gene-specific duplication or mutation mechanisms) increasing the overall  
41 organism resistance. Li and colleagues' method combining the characterization of the  
42 evolution pattern of sodium-channel mutations within eucaryote genomes and the  
43 investigation of the specific genome duplication events increasing the number of  
44 detoxication enzymes was originally intended for understanding the outstanding  
45 accumulation and transformation of PSTs within the scallop tissues.

46 The paper presents two sets of analyses performed at both genomic and molecular  
47 level for complementary toxicological investigations. The first genomic analysis reveals the

48 expansion of the family of sulfotransferase detoxification enzymes in the scallop genome,  
49 together with the selection of specific point-mutations on Nav channel protein sequence  
50 that may explain the remarkable resistance of this organisms to the PSTs<sup>5-6</sup>. The second set  
51 of investigations takes things even further. Here, the authors comprehensively studied PST  
52 detoxification in the scallop by qualitatively and quantitatively analysing a variety of PSTs in  
53 six scallop organs, as well as global gene regulation measurements, across five time  
54 points after exposure to PST-producing micro-algae. This experiment suggests that,  
55 thanks to regulation events of the gene expression of detoxification enzymes, such  
56 as *sulfo-transferases*, the scallop hepatopancreas and kidney act as two major “centers”  
57 for toxin accumulation and transformation, respectively, which may also give the scallop a  
58 powerful deterrent against predation.

59 These findings highlight how “simple” mutations and expansions in one or two key  
60 genes may have profound implications for an organism’s adaptation to the environment and  
61 the complex interactions with other organisms. This novel view combining genome and  
62 ecotoxicological investigations has broad implications for our understanding of how  
63 organisms respond to environmental stressors, and may be more widely applied in next  
64 future studies in this field.

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## 83 **Competing interests**

84 The author declares no competing financial interests.

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87 **Figure 1.** Specific evolution event driven by toxic stress pressure in *Chlamis farreri*’s genome.

Figure

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