

# Infiltration of mariner elements

SIR — Robertson reports<sup>1</sup> the presence of different families of *mariner* transposon elements<sup>2</sup> in many insects using a polymerase chain reaction (PCR) strategy and degenerated oligonucleotides from conserved sequences of the *mariner* central region. The presence of different subfamilies in the same species, together with the description of closely related *mariner* elements in distant species, suggests that the phylogenetic distribution of *mariner* in insects was due both to horizontal transfer and to an early divergence with stochastic loss in some branches<sup>3,4</sup>. Robertson failed, however, to amplify any sequence in 18 vertebrate-representative species, and he presented no data on the presence of *mariner* elements in lower invertebrates.

While analysing the 5' region of the planarian *Dugesia* (Girardia) *tigrina* (Platyhelminthes) homeobox gene *Dth-2* (ref. 5), we found an incomplete open reading frame (ORF) which bore a remarkable similarity to the transposase coded by the *Drosophila mariner* element<sup>6</sup>. We then isolated a genomic DNA fragment which included a complete transposon referred to as planarian *mariner-1* owing to its high similarity to the *mariner* transposon structure (see figure). It contains a single ORF of 339 amino acids, which shows, respectively, 35 and 55 per cent similarity to the Mos-1 *D. mauritiana* ORF (ref. 7) and the putative ORF of *Hyalophora cecropia mariner*-like element<sup>3</sup>. It also shows a significant similarity (31 per cent) to a recently available sequence of *Caenorhabditis elegans* element (GenBank accession number M98552).

This *mariner* element is present in about

8,000 copies in the *D. tigrina* genome and it is very conserved at the restriction level, as determined by genomic Southern analysis (data not shown). This high copy number, the presence of an uninterrupted ORF whose codon bias resembles that of other planarian genes<sup>8</sup> and the existence of most standard signals of active genes, all point to an active role of the *mariner* element in planarians.

Kidwell points out in News and Views<sup>9</sup> that *mariner* probably arose before the diversification of insects. Nevertheless, inter-specific horizontal transfer cannot be ruled out as it may explain *mariner* sequence similarities between some distantly related insect species. In planarians, both arguments are reinforced: we have not detected *mariner*-like sequences in the genome of the planarian *Dugesia* (Schmidtea) *mediterranea*, which suggests either horizontal transfer to *D. tigrina* or loss of the *mariner* element in *D. mediterranea* lineage. The former hypothesis may imply that horizontal transfer could involve not only species of the same class, but also species of different phyla: the latter, that *mariner* ought to be considered ancient as it may have existed before the radiation of Platyhelminthes from the branch leading to higher metazoans<sup>10</sup>.

The wide host distribution in insects and the ability of integration in another *Drosophila* species<sup>11</sup> have suggested the *mariner* element as a vector for the stable transformation in arthropods<sup>1,3,9</sup>. The presence of apparently active *mariner* transposons in planarians opens a novel perspective as these elements could be developed as an integrative system for a wide range of animal species or phyla.

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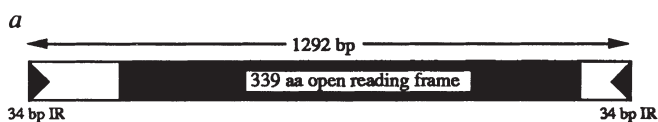
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ROBERTSON REPLIES — The *mariner* discovered by Garcia-Fernández *et al.* in *D. tigrina* is remarkably similar to those of insects. Indeed, it clusters phylogenetically within the cecropia subfamily of insect *mariners*, having 75 per cent amino acid identity with certain ant elements<sup>1</sup>. This similarity must result from horizontal transfer from an insect lineage. Other *mariners* have recently been found beyond insects. Within arthropods, they occur in a centipede and an ascaid mite<sup>1</sup>, and A. Jeyaprakash, M. A. Hoy and I have obtained *mariner* sequences from a phytoseiid mite. These elements cluster within the mauritiana subfamily of insect *mariners*<sup>1</sup>. P. Capy (personal communication) has detected *mariner* elements in two isopod crustaceans.

Beyond arthropods, two distinct *mariners* have been found in the nematode *C. elegans*. There are two copies of the element mentioned by Garcia-Fernández *et al.* in GenBank, in separate cosmids

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a, Schematic structure of the *Dugesia tigrina mariner-1* element. Black box, ORF encoding the presumptive transposase; triangles, terminal short inverted repeats. b, Comparison of the planarian *mariner-1* ORF with the transposase of the active *D. mauritiana* Mos-1 *mariner*, and the reconstructed ORFs of the *H. cecropia mariner*-like element (MLE) and of the *C. elegans* element. Dashes, identical residues (gaps have been introduced for optimal alignment); asterisks, stop codons in the aligned reading frames; hash sign, positions where a frameshift has to be considered to maintain the alignment.



b

Planarian <i>mariner-1</i>	1	MEISEIRILMKYEFHGRGATTRQAVGNINSVYPTQAVTQTTVAHFKFRFSGDFMDSNQPSRPEIKVDNDALKADVEADSSQSALELASKFVAKSIIILHLKQINKVKLKD
<i>H. cecropia</i> MLE		-ANMKY-YIYE---Y-TSAAETARR-N--GAG-AKESK-RF-Q-----I-LQ---G-----E-EI---#---P---TS-I-AG---SDKTV--Y---G-----E*
<i>D. mauritiana</i> Mos-1		MSSFVFNKQET-TVLIFC--LKK-AAESHRLVFAEFG-VP-VK-CER--Q--K-----VDDKEHGK-PKRYEDAE-Q-LLDE-DA-TQKQ--EQLE-SQQAQVSNR-REMG-IQ-VGR
<i>C. elegans</i>		MTENLLA-RHAL-GVFL---PQSCNCNE-RR-MCV-LGKSS--YN-MKF--EK-TKKNY-LDDK--*DRSRILDIDEDISRAL-D--RATSR--SATLKHQR--INH-QKTG-IE-FGQL
Planarian <i>mariner-1</i>	121	VPHELKDEHKQRLDACLSLLSRNKADPFLHRIVTCDKWKIMYDNRKRSSQWLDPEPPKHKCRKRVHQRKLMVTVWSSYGVIIHYDFMVPGTSTSDVYCSQLDDMMKLAIKQPKMFN
<i>H. cecropia</i> MLE		---SESNL-T-V-CYVT--N-HNNER.....K-----G-L--N-GD-A-S-----*LT---L-VF--T-A-----S-LKC-QT--V-I-YQ--QA-K-E--A-H-RLV-
<i>D. mauritiana</i> Mos-1		---NERQMER-KNT-EI---Y-RKS-----G-----FFNSP--KKSIV--GQ-ATSTARPNRFG--T-LC--DQS---Y-ELLK--ETVNTAR-QQ--INLNRA-QR-R-EYQK
<i>C. elegans</i>		---K-S-SQ-NCFV#LS-S--T-KRTTDVWKD-I-GND--VL-VSHT-KKE-VPVE-TATPDL-*EL-G--VLLSIGRD-K---SRELLPDFAT-NAGL--I*-EKVVAHRLHR-....
Planarian <i>mariner-1</i>	241	R.LTPILLHDNARPHSAKNTVAKLQQLGLETLRHPYSPDLAPTDFYHFFQSLDNFLSGKNFTSSGAVKTAQEFIDSRESVFTYTKGLNVLPLKQCVQDNMGGYFD
<i>H. cecropia</i> MLE		-SRSL-----T-Q-TT--NK-Q-C-----I-----RN-----H--K-N-YSV-Q--K---R-PHA-FN--I-E--VR--K-IN-N-A---
<i>D. mauritiana</i> Mos-1		-QHRV-F-----PS-T-RAVRDT-ET-NW-V-P-AA-----S--L-A-MGHA-AEQR-D-YES--KWL-D-WFAAKDDE--WR-IHK--ER-EK--ASD-K-E-
<i>C. elegans</i>		-GSKLL-----TTFK-RQ-----TV-IQI-SY-S-----L-R--Q-H-A-QK-HDRKV-E-GLDD-FA-*SQE-*AE-TVQ---C--EVIGIN-K-ITH