



Evolutionary nightmare: Parasites pass on their manipulatory characteristics

March 19, 2019 | Stephanie Schnydrig

Topics: Ecosystems

In order to move from one host to another, certain parasites change their behaviour. The more effectively a parasite can manipulate its host, the greater its evolutionary advantage. It therefore passes on its characteristics to its descendants, as a new Eawag study has shown.

Many parasites move from host to host several times during their life cycle, including the parasitic tapeworm *Schistocephalus solidus*, which infects three hosts altogether. Its life cycle starts in the Cyclops, a small copepod, which feeds on the larvae of the tapeworm. After one to three weeks, the Cyclops has to be ingested by a three-spined stickleback, as the tapeworm larvae need to be inside the latter in order to continue to grow.

However, a Cyclops will normally become immobile as soon as it experiences an imminent threat—a sensible camouflage strategy to avoid being eaten by predators. “As soon as the parasite is mature enough to continue its life cycle in the stickleback, though, the Cyclops actually swims more actively when it encounters the threat stimulus!” says Nina Hafer-Hahmann, a postdoctoral researcher in the Department of Aquatic Ecology, and a specialist in parasite-host interactions. Thanks to this change in behaviour, the Cyclops becomes easy prey for the stickleback which the parasite wants to inhabit.

After several more months, the stickleback then needs to be eaten by a bird, in which the tapeworm will finally reproduce. This kind of interhost migration has been observed by scientists in numerous parasites.

Coincidence or active host manipulation?


```

mh0dHA6Ly93d3cudzMub3JnLzE5OTkveGxpbmsilHg9ljBweClgeT0iMHB4liB2aWV3Qm94P
SlwIDAgMTIiMTIiIHNoeWxIPSJlbnFibGUtYmFja2dyb3VuZDpuZXcgMCAwIDEyIDEyOylgeG
1sOnNwYWNIPSJwcmVzZXJ2ZSI+PHN0eWxIIHR5cGU9InRleHQvY3Nzlj4uc3Qwe2ZpbGw6
lzg4ODg4ODt9PC9zdHlsZT48cGF0aCBpZD0iQm9yZGVyIjBjbGFzc20ic3QwliBkPSJNMTEsM
TFIMFYwaDExVjExeiBNMTAsMUgxdjloOVYxeilvPjxnIGlkPSJJbm5lcil+PHJlY3QgeD0iMilgeT
0iNSIgy2xhc3M9InN0MCIgd2lkdGg9ljcilGhlaWdodD0iMSlvpjwvZz48L3N2Zz4=)}.extbase-
debugger{display:block;text-align:left;background:#2a2a2a;border:1px solid #2a2a2a;box-
shadow:0 3px 0 rgba(0,0,0,.5);color:#000;margin:20px;overflow:hidden;border-radius:4px}.ext
base-debugger-floating{position:relative;z-index:999}.extbase-debugger-
top{background:#444;font-size:12px;font-family:monospace;color:#f1f1f1;padding:6px
15px}.extbase-debugger-center{padding:0 15px;margin:15px 0;background-image:repeating-
linear-gradient(to bottom,transparent 0,transparent 20px,#252525 20px,#252525
40px)}.extbase-debugger-center,.extbase-debugger-center .extbase-debug-string,.extbase-
debugger-center a,.extbase-debugger-center p,.extbase-debugger-center pre,.extbase-
debugger-center strong{font-size:12px;font-weight:400;font-family:monospace;line-
height:20px;color:#f1f1f1}.extbase-debugger-center pre{background-color:transparent;margin:
0;padding:0;border:0;word-wrap:break-word;color:#999}.extbase-debugger-center .extbase-
debug-string{color:#ce9178;white-space:normal}.extbase-debugger-center .extbase-debug-
type{color:#569CD6;padding-right:4px}.extbase-debugger-center .extbase-debug-
unregistered{background-color:#dce1e8}.extbase-debugger-center .extbase-debug-
filtered,.extbase-debugger-center .extbase-debug-proxy,.extbase-debugger-center .extbase-
debug-ptype,.extbase-debugger-center .extbase-debug-visibility,.extbase-debugger-center
.extbase-debug-scope{color:#fff;font-size:10px;line-height:12px;padding:2px 4px;margin-
right:2px;position:relative;top:-1px}.extbase-debugger-center .extbase-debug-
scope{background-color:#497AA2}.extbase-debugger-center .extbase-debug-
ptype{background-color:#698747}.extbase-debugger-center .extbase-debug-
visibility{background-color:#698747}.extbase-debugger-center .extbase-debug-
dirty{background-color:#FFFFB6}.extbase-debugger-center .extbase-debug-
filtered{background-color:#4F4F4F}.extbase-debugger-center .extbase-debug-seeabove{text-
decoration:none;font-style:italic}.extbase-debugger-center .extbase-debug-
property{color:#f1f1f1}.extbase-debugger-center .extbase-debug-
closure{color:#9BA223;}Extbase Variable Dumparray(2 items) publications => '18357' (5
chars) libraryUrl => '' (0 chars) Extbase Variable Dumparray(1 item) 0 =>
Snowflake\Publications\Domain\Model\Publicationprototypepersistent entity (uid=18357,
pid=124) originalId => protected18357 (integer) authors =>
protected'Hafer-Hahmann,&nbsp;N.' (22 chars) title => protected'Experimental evolution of
parasitic host manipulation' (53 chars) journal => protected'Proceedings of the Royal Society
B: Biological Sciences' (55 chars) year => protected2019 (integer) volume => protected286
(integer) issue => protected'1895' (4 chars) startpage => protected'20182413 (8 pp.)' (16
chars) otherpage => protected'' (0 chars) categories => protected'host manipulation;
Schistocephalus solidus; energetic costs; extended phenot
ype; response to selection; experimental selection' (126 chars) description =>
protected'Host manipulation is a parasite-induced alteration of a host's phenotype tha
t increases parasite fitness. However, if genetically encoded in the parasit
e, it should be under selection in the parasite. Such host manipulation has
often been assumed to be energetically costly, which should restrict its evo
lution. Evidence of such costs, however, remains elusive. The trophically tr
ansmitted cestode <em>Schistocephalus solidus</em> manipulates the activity

```

of its first intermediate copepod host to reduce its predation susceptibility before the parasite is ready for transmission. Thereafter, *S. solidus* increases host activity to facilitate transmission to its subsequent fish host. I selected *S. solidus* for or against host manipulation over three generations to investigate the evolvability of manipulation and identify potential trade-offs. Host manipulation responded to selection, confirming that this trait is heritable in the parasite and hence can present an extended phenotype. Changes in host manipulation were not restrained by any obvious costs.' (1076 chars) serialnumber => protected'0962-8452' (9 chars) doi => protected'10.1098/rspb.2018.2413' (22 chars) uid => protected18357 (integer) _localizedUid => protected18357 (integer)modified _languageUid => protectedNULL _versionedUid => protected18357 (integer)modified pid => protected124 (integer) Hafer-Hahmann, N. (2019) Experimental evolution of parasitic host manipulation, *Proceedings of the Royal Society B: Biological Sciences*, 286(1895), 20182413 (8 pp.), doi:10.1098/rspb.2018.2413, [Institutional Repository](#)

Related Links

The friend of my enemy is my enemy

<https://www.eawag.ch/en/info/portal/news/news-archive/archive-detail/evolutionary-nightmare-parasites-pass-on-their-manipulatory-characteristics>