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Supercool social wasps: lower lethal limits to cold tolerance

Of the selective pressures that have shaped species evolutionary success or failure, the most universal abiotic factor, is probably temperature. In the higher latitudes the ability to survive cold temperatures may be the limiting factor to historical species radiation, distribution and abundance. Because insects are the most diverse fauna on earth, inhabiting the planet from pole to pole, the study of insect cold tolerance has received increased scrutiny. In temperate regions of North America, such as eastern Washington State, overwintering queens of the social wasps (Hymenoptera: Vespidae), the yellowjackets and paper wasps, must survive sustained sub-zero winter temperatures. Because freezing of intracellular fluids invariably causes damage to cell membranes, it is usually lethal to the organism. To ascertain the lethal limits to low temperature survival of vespid wasps, we measured the supercooling points (SCPs) of gynes from four species representing three genera of locally occurring social wasps. In all cases, a seasonal progression in cold hardening was observed; as fall advanced into winter, supercooling ability increased, resulting in progressively lower SCPs. Though data in some cases indicated differences between genera, we found that most local wasps in the heart of winter are able to survive at least brief exposures below -20°C. Mean midwinter SCPs were as follows: *Dolichovespula maculata*, -20.1; *Vespula pensylvanica*, -22.3; *Vespula germanica*, -22.6; *Polistes dominulus*, -23.3. No wasp in our study survived freezing, even those inoculated by external ice. Our data indicate that the vespid wasps in eastern Washington State are not tolerant to freezing, and instead survive winter by the ability to supercool below temperatures that are generally experienced in hibernacula.

27.4 COSTELLO, MJ*; BOXSHALL, GA; BOYKO, CB; HOEG, JT; MARKHAM, J; APPLÉTANS, W; University of Auckland, Natural History Museum, London, American Museum of Natural History, University of Copenhagen, Arch Cape Marine Laboratory, Flanders Marine Institute; m.costello@auckland.ac.nz

How can we best make authoritative biological information available online?

Following on from the presentation on Development of a sustainable authoritative online species databases, we propose an open discussion on how our community can best communicate and publish content on the internet. Several scientists currently involved as Taxonomic Editors of the World Register of Marine Species (www.marinespecies.org) will be at the Symposium on Parasitic Crustacea, namely Geoff A. Boxshall, Mark J. Costello, Christopher B. Boyko, Jens T Hoeg, and John Markham. Others may also be speaking at parallel symposia, and delegates may also know of authoritative online resources that should be linked to, that need a more permanent host institution, or that could easily be created from content at hand. In principle, experts should only have to publish the content online once, and from there it can be linked and accessed by other resources, with appropriate attribution and citation. We propose a short open forum to invite comments on the current online resources and how these can be developed to best communicate quality-assured content online.

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Progress in understanding the ecology of sea lice, copepod parasites of wild and farmed salmonids

Fish farmed in sea cages may become infested by parasites from wild fish, and in turn become point sources for parasites. Sea lice are the best studied example of this risk. They are the most significant parasite in salmon farming in Europe and the Americas, costing the aquaculture industry US\$400 million a year. A recent review indicates that they are also pathogenic to some wild fish under natural conditions. Epizootics are rare in wild fish populations, but have occurred on wild fish in areas where farms have sea lice infestations, notably Europe, east and west coasts of North America, and Chile. Recent reviews and modelling studies now provide an understanding of the mechanisms of how the salmon louse, *Lepeophtheirus salmonis*, can infest wild salmonids from farm sources. Three-dimensional hydrographic models predict the distribution of the planktonic salmon lice larvae best when they include wind driven surface currents and larval behaviour. *Caligus* species can also cause problems on farms and transfer from farms to wild fish, and this genus occurs worldwide. The increasing evidence that lice from farms are a significant cause of mortality on nearby wild fish populations provides a challenge for the farms to control lice, but also raises conservation, economic, and political issues about how to balance aquaculture and fisheries resource management. Current and possible additional strategies to control lice are outlined.

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Does urea affect the calcium binding properties of parvalbumin and thereby alter muscle relaxation in trout?

Parvalbumin (PV), a myoplasmic protein with multiple isoforms in fish muscle, is a low molecular weight protein (9-11 kD) that appears to aid in relaxation from contraction. PV binds free Ca^{2+} , which reduces the intracellular concentration of the ion and leads to muscle relaxation. The impact of PV on muscle relaxation depends on both the rate of Mg^{2+} dissociation as well as the rate of Ca^{2+} binding. Work in elasmobranchs has shown that the binding properties of some isoforms of PV are labile to physiological concentrations of urea. For instance, marine elasmobranchs can have concentrations of urea in their tissues on the order of 200-300 mM. At such concentrations, urea reportedly leads to increased binding affinity of PV for Ca^{2+} (lower Ca^{2+} K_D). We tested this hypothesis by manipulating urea content of muscle in mechanics experiments. Using rainbow trout as the experimental subject, contractile properties were measured in white, fast-twitch muscle bundles in physiological saline containing zero, 200 and 400 mM urea. The time for muscle bundles to relax from contraction decreases with increasing urea content. Further, the effect is reversible lowering urea content leads to longer muscle relaxation times. These preliminary experiments suggest urea content influences muscle relaxation, perhaps by altering the binding properties of PV, and may therefore affect swimming behavior in some fishes.