ROS membranes involves mainly the membrane proteins[25] and that the activation energy relating to this reaction undergoes a drastic change around 30 °C[26].

Whatever the molecular origin of the various transitions may be, they indicate unquestionably the presence of an heterogeneous structure in ROS. If a liquid semi-crystalline equilibrium exists in ROS membranes, it could be modified under light influence since the membrane fluidity increases after illumination[27, 28].

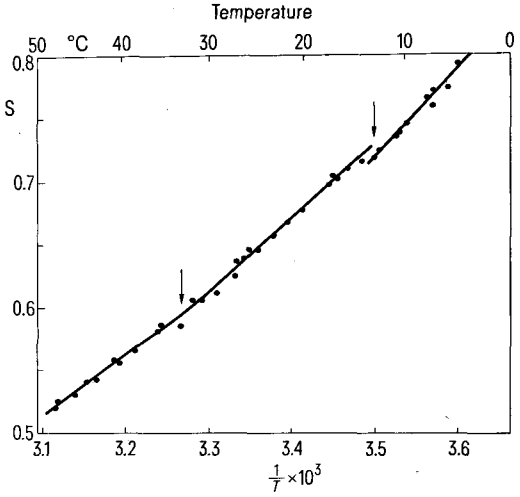

Fig. 4. Order parameter for spin label I(12,3) incorporated in rod outer segment membranes versus $1/T$. 5 mg of lyophilized material in 35 µl of *Tris*-HCl buffer. Label concentration 2:100 w/w.

Résumé. La technique du marquage par spin est utilisée pour étudier l'inhomogénéité de la distribution des lipides dans les membranes des segments externes des bâtonnets. Cette étude révèle la présence de trois transitions respectivement à 16°, 34° et 60 °C. La transition à 34 °C traduit vraissemblablement une modification de l'interaction entre les lipides et la rhodopsine.

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Effect of Water Temperature on the Predatory Efficiency of *Gambusia affinis*

Predation of mosquito larvae by the fish *Gambusia affinis* has so far been studied with reference to the influence of several biotic factors concerning either the prey or the predator[1, 2]. The occurrence, distribution and success of aquatic predators may also be largely dependent on the physico-chemical conditions operative in natural waters[3]. The physico-chemical complex of freshwater bodies where mosquitoes breed are known to fluctuate from time to time[4]. Maglio and Rosen[5] observed that the feeding behaviour of *G. affinis* was a direct response to the water temperature. A deeper knowledge on the effect of water temperature influencing the predatory efficiency of *G. affinis* would give an insight into the regulatory control mechanism of several mosquito populations by this predator.

Materials and methods. A B.O.D. incubator, with arrangements for illumination, was used to maintain constant temperature of 20, 25 or 30 °C. Illumination was controlled for 10 h per day during the experimental period. *Gambusia affinis* collected from field were grouped into male, non-gestating female and gestating female, depending on their sex and physiological state. 5 individuals of similar body size were taken from each group by random choice for each experiment. The fish were placed in aquaria containing 1 l aerated freshwater. The fish were acclimated in these aquaria to the respective temperature for 3 days prior to the start of the experiment. The experimental food organisms, consisting of 25 live 4th instar larvae of *Culex fatigans*, were introduced into each of the aquaria without disturbing the test fish. The prey was exposed to predation for 10 h a day. Since the experiments were repeated on 3 successive days, the performance of 5 individuals yielded a total of 15 observati ons in each series.

Results. On an average, a non-gestating female predated 12 larvae in 10 h at 20 °C and its predatory efficiency increased to a maximum of 23 larvae with increase in temperature to 30 °C (Table). Gestating females also increased their predatory efficiency from 16 larvae at 20 °C to 24 larvae at 30 °C. The differences observed in the predatory efficiency at the 3 selected temperatures for these fish were statistically significant. Male *Gambusia affinis* predated only 10.5 larvae at 20 °C, while at 30 °C the fish predated 15 larvae. The increase observed in predatory efficiency of male at 25 °C was not significant. Thus, the magnitude of reduction in predatory efficiency depends upon sex and physiological status of the fish. Nongestating and gestating females exhibited increase in predatory efficiency with 5 °C rise in temperature, while male displayed similar increase only when there was 10 °C rise in temperature. Similar dependence of predatory efficiency on sex and physiological state of this fish was also observed when the space provided per fish was changed[6].

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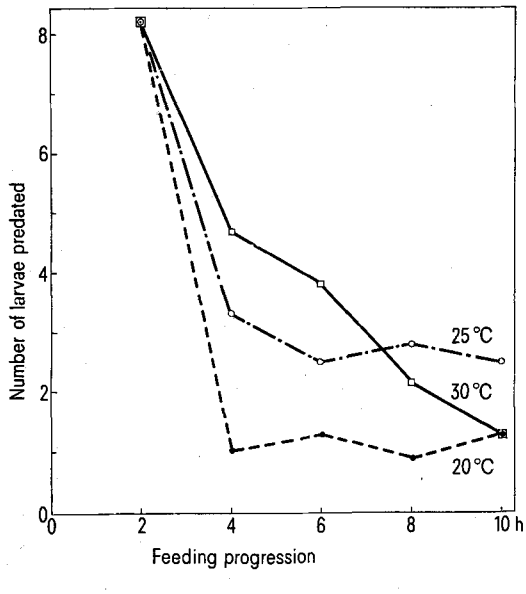
Effect of temperature on the predatory efficiency (number of mosquito larvae predated in 10 h) of *Gambusia affinis*

Sex and physiological state	Temperature (°C)			*P*-value and significance level		
	20	25	30	1 Vs 2	2 Vs 3	1 Vs 3
Male	10.1 ± 3.4	11.2 ± 4.9	15.0 ± 4.9	0.774 $0.20 > p < 0.10$ Insignificant	2.134 $0.05 > p < 0.10$ Significant	3.182 $0.01 > p < 0.001$ Significant
Female non-gestating	12.3 ± 3.9	16.5 ± 3.2	22.6 ± 2.6	3.360 $0.01 > p < 0.001$ Significant	4.122 $p > 0.001$ Significant	8.583 $p > 0.001$ Significant
Female gestating	15.5 ± 4.4	20.4 ± 3.9	23.8 ± 4.6	3.223 $0.01 > p < 0.001$ Significant	2.128 $0.05 > p < 0.02$ Significant	4.980 $p > 0.001$ Significant

Each value is the mean of 15 experiments with standard deviation

A significant feature was observed in feeding progression of the fish tested at the 3 temperatures. Irrespective of the water temperature, sex and physiological state, the fish predated a maximum of 8.2 larvae during the first 2 h (Figure). A steep decrease in predatory efficiency (85%), during the second successive 2-hour interval was noticed only at 20 °C.

Discussion. Gambusia affinis has been observed to thrive in different natural habitats, whose temperatures ranged from 24 to 36 °C[7–9]. The observations made during the present experiment suggest that *G. affinis* responds thermotactically, and water temperature appears to be the overriding stimulus that regulates the predatory efficiency. A similar dependence on temperature of water for feeding was reported by MAGLIO and ROSEN[5]. The magnitude of temperature dependence is further influenced by sex and physiological state of the fish. Male *G. affinis* responded only when the water temperature was increased by 50%, while non-gestating and gestating females responded to 25% increase in temperature. HAGEN[8] reported that females of *G. affinis* were more tolerant to heat than males. Temperature did influence the behaviour of both the predator and the prey. The larvae were sluggish at 20 °C, thus being more susceptible to the predator, yet the fish predated fewer larvae than expected. This may probably be because the metabolic activity of the fish was also considerably lowered. KATRE[10], also reported that the food intake in *G. affinis* was minimum at 20 °C and maximum at 30 °C. Optimum temperature for growth of another related cyprinodont fish *Lebistes reticulatus* was reported to be in the range of 23 to 25 °C[11]. It may be concluded that there is an optimum temperature for predatory efficiency of *G. affinis* and, if given a choice, this fish will select the most comfortable temperature for effective predation of mosquito larvae.



Feeding progression (number of larvae predated at intervals of 2 h) of *Gambusia affinis at* 20°, 25° and 30 °C. Each value is the mean of 3 groups of test fish.

Zusammenfassung. Fütterungsversuche an *Gambusia affinis* zeigten, dass die Anzahl der Mückenlarven, die von den Fischen gefressen werden, bei erhöhter Wassertemperatur zunimmt. Es scheint, dass diese Reaktion weitgehend von Geschlecht und physiologischem Zustand abhängig ist.

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