Synchronous gamete maturation and reliable spawning induction method in holothurians

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Abstract

Several years of research on the gametic development and spawning of different species of holothurians have produced results that find applications in aquaculture and fisheries management programs. The first set of data shows that sea cucumbers secrete a biologically active chemical which allows gamete synthesis synchrony among conspecifics. Laboratory experiments have revealed that the gametic development was significantly less synchronous among individuals that were maintained separately under natural environmental conditions than it was among similarly treated individuals kept in groups. Furthermore, the presence of mature individuals was found to induce the gametic development of less mature ones. The active substance is present in the mucus secreted by the body wall enabling it to travel fair distances, although transmission is often favoured by pairing and aggregative behaviours. These findings indicate that the lunar cycle, photoperiod, food supply and temperature cannot individually account for the onset and synchronization of reproduction, but rather that environmental cues act synergistically and can be transmitted within and between populations through chemical communication. This has repercussions on both fisheries and aquaculture techniques. Preserving untouched populations while fishing intensively on other grounds should be favoured compared to steadily lessening the biomass, whereas broodstock should be maintained in a way that promotes interactions long before the breeding period.

The other aspect of the study arose from the fact that holothurians are among the most commercially valuable echinoderms for which successful spawning induction is still difficult to obtain on a reliable basis. Recent results show that the transfer of perivisceral coelomic fluid (PCF) can be used as a reliable tool to induce spawning in mature individuals. PCF collected from individuals that had been in the typical spawning posture for about 20 min, without shedding gametes, triggered spawning in 71-100 % of conspecifics. The individuals responded to the injection of a 2-3 ml aliquot by displaying the spawning posture within 30-62 min, followed by massive gamete broadcast 57-83 min later. The results varied according to the time of PCF collection with respect to the spawning activity of the donor and the amount of PCF injected. The triggering substance was found not to be sex-specific since positive responses were observed in individuals of the same or opposite sex as the donor. Thus, PCF collected from early spawners can be used to spread and maximize spawning among the entire broodstock.

Keywords: Chemical ecology, coelomic fluid**,** gametogenesis, reproduction, sea cucumber

海参配子的同步成熟和可靠的诱导配子释放的方法

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摘要

多年来对不同种类海参的配子发育和释放所得到的研究结果在水产养殖和渔业管理上得到了应用。第一手的资料表明，海参释放出一种生物学活性物质，该物质可以使得同一物种的配子同步生成。实验室的研究表明，如将不同个体分别放在不同的自然条件下，其配子的发育的同步性显著地差于处在同一条件下的配子发育。还进一步显示，成熟的个体有诱导不太成熟个体的性腺发育。海参的活性物质存在于其体壁分泌的黏液中，能传播相当远的距离，起到引诱配对和群聚的作用。这一发现指出，月相的周期变化、光周