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The Occurrence of the Freshwater Clams, *Musculium partumeium* (Say) and *Pisidium casertanum* (Poli) (Bivalvia: Sphaeriidae), in the Hawaiian Islands

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Abstract—Sphaeriid clams were collected from an ancient, continuously cultivated taro pond complex at Ke'anae Peninsula, Maui. Both species are known for adaptations for temporary pond habitats and could have been initially introduced by the earliest Hawaiian settlers transported with moist taro root stock from other areas of Oceania.

Clams in the family Sphaeriidae are one of two major groups of freshwater bivalves. These clams are small (maximum shell lengths < 25 mm), hermaphroditic, ovoviviparous, and global in their distribution. Sphaeriid clams are found in virtually all freshwater habitats including lakes, rivers, ephemeral ponds and ditches, and the profundal zone of deep oligotrophic lakes. The family is divided into three primary (four if *Eupera* is listed) genera: *Pisidium*, *Musculium*, and *Sphaerium*. The genus *Pisidium* contains 24 species, is small (most are < 6 mm shell length), and has global distribution. The genus *Musculium* has four species, can attain shell lengths > 20 mm, and is globally distributed. These clams have been shown to dominate the benthos in terms of both numbers and biomass and contribute significantly to the production dynamics of aquatic systems (see review by Burky 1983). North American populations of *Pisidium* and

Musculium have been extensively studied by Mackie et al. (1976), Mackie & Qadri (1976), Way et al. (1980), Way & Wissing (1982), Burky et al. (1985), Bailey & Mackie (1986), Hornbach & Childers (1987), Hornbach & Cox (1987), and Way (1989).

This brief note reports the occurrence of the sphaeriid clams, *Musculium partumeium* and *Pisidium casertanum*, in the Hawaiian Islands. Preliminary size range data are provided from an ongoing research project into the seasonal life of *M. partumeium* and *P. casertanum*. Identifications were confirmed by Dr. Daniel Hornbach at Macalaster College.

M. partumeium and *P. casertanum* were first collected in benthic samples taken from Ke'anae taro ponds on the island of Maui on June 15, 1990. Ke'anae is a small peninsula located on the windward (northeastern) side of Maui about 12 statute miles from the town of Hana. The Ke'anae community has presumably been a producer of kalo, or taro (*Colocasia esculenta*), a staple in local diets since early native settlement some 1,500 years ago. Kalo wai or 'wet' taro is grown in flooded, banked, and terraced ponds or paddies. The taro ponds are maintained as an intricate network interconnected by ditches which transport freshwater from nearby Pi'ina'au Stream through the taro fields and back to either the stream or ocean. The substrate is composed of silt, sand and detritus. The ponds are essentially ephemeral habitats with periodic flooding and draining associated with planting, cultivation and harvesting of taro. The pond network forms a thermal sequence, from stream input to discharge, with the warmest paddies most distal from the water source. During cultivation, ponds are maintained at 25 cm depth. Ponds can be individually drained and refilled as needed for agriculture and/or apple snail control (*Pomacea canaliculata*, a crop pest which was introduced about 1989; Cowie 1993) with the warmest ponds being drained most frequently. Throughout the system the sphaeriid clams are found in both ponds and the interconnecting canal system.

We have made monthly collections of at least 100 individuals of both species from several ponds since July 1990. During the sampling period, shell lengths of *M. partumeium* and *P. casertanum* have ranged from 1.4–7.8 mm and 0.8–4.2 mm, respectively. Both species have a lifespan of approximately 1–1.5 years. It is probably that spat (= newborns) of both species are capable of surviving in the moist substrates after drainage of a pond. This ability to survive in ephemeral ponds is documented for these species (see Burky 1983).

Sphaeriid clams have evolved effective mechanisms for dispersal between aquatic habitats. Juvenile sphaeriids can be transported on the legs of aquatic insects, the limbs of salamanders, and the feathers of waterfowl (Burky 1983). Juveniles can also survive ingestion by diving ducks, which permits relatively long-distance dispersal (Mackie 1979). Additionally, the sphaeriids are hermaphroditic, so a single individual can potentially start a population in a new habitat. These factors, along with the ability to survive in harsh habitats (e.g., ephemeral pond conditions are mimicked by the practices of taro cultivation), has led to the group's global distribution. It is probable that an extensive survey of taro ponds

and natural wetlands would extend the distribution of these clams to all of the major islands where suitable habitat exists. Further, it is probable that these clams have been continuously reintroduced in association with taro cultivation and the exchange of root stock from elsewhere in Polynesia (spat could presumably survive in association with transported root stock) over the approximately 1,500 year history of native Hawaiian culture. A statewide clam distribution would suggest the potential of ancient native introductions, whereas a patchy distribution would indicate recent colonizations.

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