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Conover R J. Assimilation of organic matter by zooplankton.
Limnol. Oceanogr. **11**:338-45, 1966.
[Woods Hole Oceanographic Institution, MA]

A method is described that uses insoluble ash as a tracer to measure, in the laboratory or in the field, the percentage assimilation of organic matter by zooplankton. Knowledge of the amount of food ingested and quantitative recovery of feces are not required. [*The SCI®* indicates that this paper has been cited in over 160 publications since 1966.]

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Early attempts to measure grazing by herbivorous planktonic animals using radioactive tracers yielded rather low estimates of ingestion but, surprisingly, very high assimilation efficiencies. At that time, there was a large gap between feeding rates measured in the laboratory and those measured in the field. The field populations supposedly were engaged in "superfluous feeding"[1] by ingesting beyond their needs during bloom periods while assimilating only a small fraction of what they consumed. To test this theory and to examine feeding and assimilation by zooplankton without the use of isotopes, I sought an inert tracer to be placed in the animal's food. The tracer would pass the animal's gut unaltered and could then be compared with the organic materials being digested.

Previously, insoluble compounds had been mixed into the diets of large animals to serve as digestive tracers, but altering the natural diet of copepods in analogous fashion did not appear feasible. Since diatoms with insoluble silica shells were an important part of the diet of planktonic herbivores, I first tried using biogenic silica. Without the range of laboratory plastics available today, I could not make the then-available silicon fusion methods, required to convert insoluble glass to soluble form, sufficiently sensitive to measure the few micrograms of silica that were available in copepod feces. About then, I began to use quartz helixes to weigh small amounts of planktonic material, and I wondered if I could measure my silicon tracer as weight after incineration using these highly sensitive but extremely delicate "glass springs." The biggest problem was finding a "crucible" small enough to be tared on my most sensitive helix with a total working range of 2 mg. Circles, 3 mm in diameter, of the thinnest commercially available platinum foil were finally used with a specially constructed panholder of crossed microfibers of quartz. To sneeze would have been total disaster! Fortunately, my eyes were better then, and I worked out a method of weighing silicon-containing ash in 5-10 μg of dry fecal pellets. The so-called ash-ratio method of determining assimilation resulted.

As originally developed, the method was not intended for general use, being heavily dependent on the fact that most of the ash from diatoms, and feces produced from them, was highly refractory silica. Still, it was so simple, requiring only a good balance and a muffle furnace, that it became widely used and misused by ecologists studying energy transfer in food chains. Several citations have pointed out its deficiencies when most of the ash is soluble.[2,3] Where the diet can be manipulated, chromium compounds have been combined with isotopic labelling.[4] More recently, we have returned to biogenic silica as a tracer in feeding studies with Arctic herbivores, which feed primarily on diatoms living on the underside of sea ice, using refinements to an analytical silicon method introduced by Paasche.[5]

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2. **Pavlyutin A P.** A contribution to the method of determination of food assimilation in aquatic animals. *Zool. Zh.* **49**:288-93, 1970.
3. **Forster J R M & Gabbott P A.** The assimilation of nutrients from compounded diets by prawns *Palaemon serratus* and *Pandalus platyceros*. *J. Mar. Biol. Assn. UK* **51**:943-61, 1971.
4. **Calow P & Fletcher C R.** A new radio tracer technique involving ^{14}C and ^{51}Cr, for estimating the assimilation efficiencies of aquatic, primary consumers. *Oecologia* **9**:155-70, 1972.
5. **Paasche E.** Silicon content of five marine plankton diatom species measured with a rapid filter method. *Limnol. Oceanogr.* **25**:474-80, 1980.