Chapter 2
Description of the Innovative Sediment Sampler

Core samplers are commonly used to collect sediment profiles in order to assess the vertical distribution of sediment characteristics. Based on the method of sample collection, core samplers may be broadly classified into two categories: (1) end-filling core samplers and (2) side-filling core samplers (Faegri and Iversen 1989). In general, an end-filling sampler consists of one or more core tubes or a box that collects sediment from the bottom end of the sampler as it is pushed through the sediment. An end-filling sampler generally collects sediment from the sediment surface down to a particular depth. Once the core sample is extruded through the end of the sampler, a discrete depth interval of the core sample may be subsampled. Examples of end-filling samplers include the Hand Corer, Split Core Sampler, Dual Tube Liner Sampler, Vibrocorer, and Ekman Grab. Additional details on end-filling samplers are provided by Environment Canada (1994), Blomqvist (1991), Faegri and Iversen (1989), Aaby and Digerfeldt (1986), and Downing (1984).

A side-filling core sampler is operated by first driving the sampler to a particular depth. The core tube is then rotated clockwise to fill the tube by cutting out a segment of sediment. A large cover plate attached to the core tube holds the sampler stationary while the tube rotates clockwise to collect the sediment. Resistance offered by the sediment keeps the cover plate stationary, allowing the core tube to rotate. Examples of side-filling samplers include the Russian sampler and the Hiller sampler (Faegri and Iversen 1989). The Russian sampler was described first by Belokopytov and Beresnevich (1955) and later by Jowsey (1966). Additional details on the Hiller sampler are provided by Faegri and Iversen (1989) and by Aaby and Digerfeldt (1986).

This chapter describes the Russian Peat Borer designed and fabricated by ARI. ARI developed the Russian Peat Borer during the early 1990s, improving on similar Russian samplers that have been used since the 1950s. Sections 2.1 through 2.4 describe the Russian Peat Borer, discuss its general operating procedures, outline its advantages and limitations, and provide developer contact information. Similar information for the reference samplers used during the demonstration is provided in Chapter 5.

2.1 Sampler Description

Components of the Russian Peat Borer include (1) a stainless-steel core tube; (2) 40-inch-long, 1-inch-diameter, aluminum extension rods; (3) a stainless-steel turning handle; and (4) a Delrin® core head and bottom point that support a stainless-steel cover plate (see Figure 2-1). The cover plate is curved and sharpened to minimize disturbance when the sampler is inserted into sediment. The core tube is hinged to the cover plate by two stainless-steel pivot pins at the top and bottom of the plate. Support

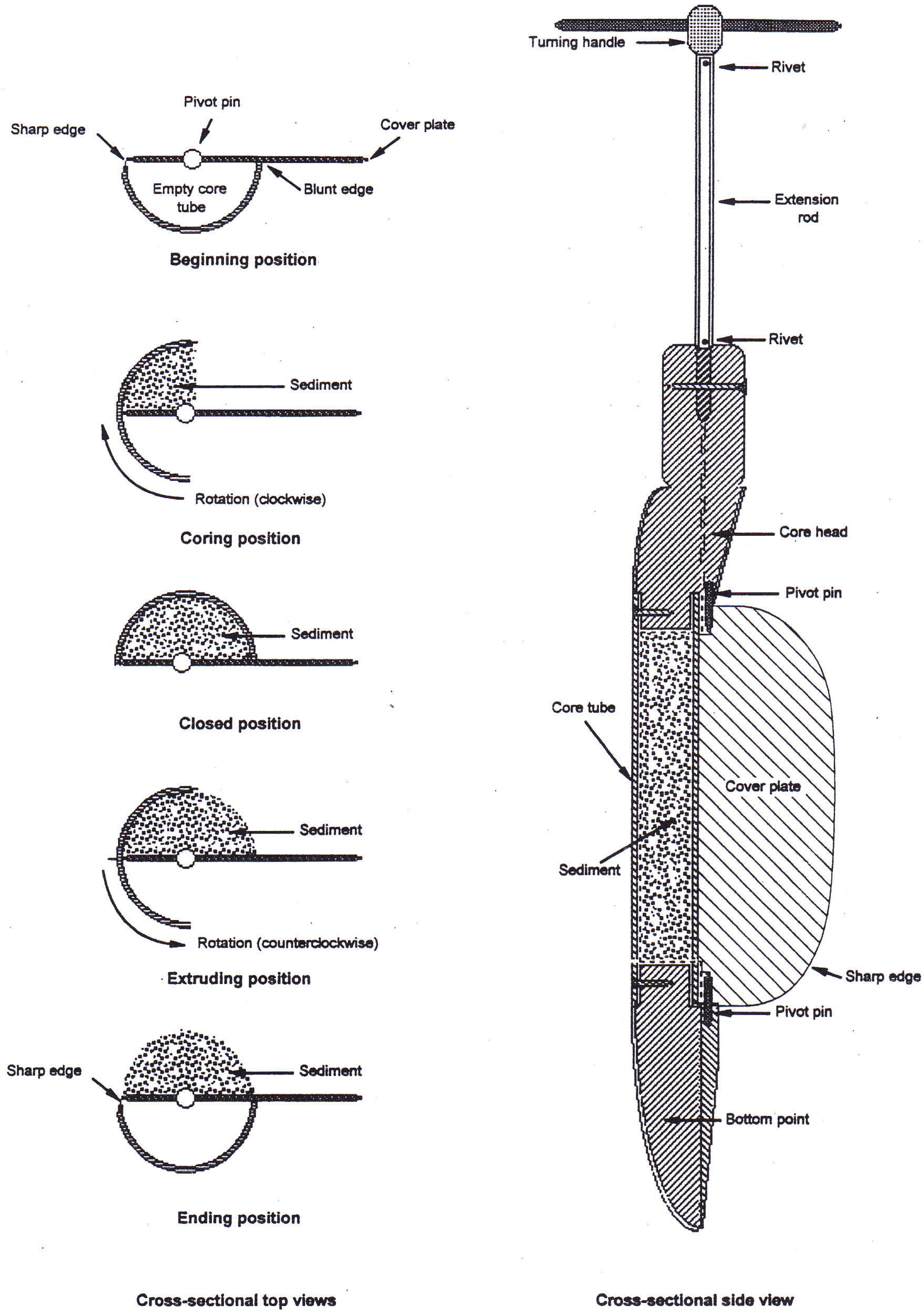

Figure 2-1. Russian Peat Borer.

equipment for operation of the sampler may include a slide-hammer mechanism and 10-foot-long, 1.3-inch-diameter, magnesium-zirconium extension rods. The Russian Peat Borer is readily available in three separate models whose specifications are presented in Table 2-1. ARI will also manufacture Russian Peat Borers of different design specifications upon request.

Table 2-1. Russian Peat Borer Model Specifications

	Core Tube		Design Volume (mL)		
Model[a]	Length (inch)	Inside Diameter (inch)	Per Inch	Maximum	Weight[b] (lb)
A	20	2	26	500	5.5
B	40	2	26	1,050	15
C	25	3	58	1,450	14

Notes:

lb = Pound
mL = Milliliter

[a] The model designations are specific to this report and are not used in the developer's product catalog.

[b] The weight shown does not include extension rods; each 40-inch-long, 1-inch-diameter, aluminum extension rod weighs about 2 lb.

The Russian Peat Borer is manually inserted into sediment in the beginning position, and the core tube is turned 180 degrees clockwise until the sharp edge of the tube contacts the cover plate. This procedure allows the sharp edge of the core tube to rotate and longitudinally cut through the sediment, collecting a semicylindrical sediment core that is 2 inches in diameter. Resistance offered by the sediment holds the cover plate stationary, allowing the core tube to rotate. The cover plate also provides support so that the collected material is retained within the core tube.

The Russian Peat Borer is innovative because the core head and bottom point are made of Delrin®, a thermoplastic polymer that has a high modulus of elasticity as well as strength, stiffness, and resistance to abrasion and the degrading effects of moisture. Earlier sediment samplers with a similar design were typically made entirely of stainless steel and therefore were heavy; the use of Delrin® has made the sampler lighter. In addition, ARI limited the thickness of the stainless-steel cover plate and the core tube to 2 millimeters in order to minimize the resistance created by the sediment during sampler deployment and core tube rotation. Finally, according to ARI, the optional, 10-foot-long, 1.3-inch-diameter, magnesium-zirconium rods available for sampler deployment to depths greater than 50 feet below sediment surface (bss) are durable, light in weight, and easily coupled and uncoupled.

2.2 General Operating Procedures

The Russian Peat Borer can be operated by one person from a platform, from a boat, or while wading in shallow water. Figure 2-1 presents a five-stage depiction of the Russian Peat Borer operating procedures. The sampler is operated by manually inserting the bottom point of the sampler into the sediment with the blunt edge of the core tube turned against the cover plate to prevent sediment from entering the tube during penetration. A slide-hammer mechanism can be used to drive the sampler through highly consolidated sediment or peat that is hard to penetrate. Accurate depth of penetration measurements depend on accurate assessment of the sediment surface. To accurately assess the location of the sediment surface, an underwater video camera is recommended because it may allow immediate visual inspection and recording of sampling attempts.

Once the sampler is driven into the sediment to the desired depth, the turning handle is manually turned 180 degrees clockwise, allowing the sharpened edge of the core tube to longitudinally cut through the sediment. The sampler reaches the closed position once the sharp edge of the core tube is in contact with the cover plate. Once it is in the closed position, the sampler can be manually retrieved. As the sampler is retrieved within the sediment, a constant, clockwise pressure on the sampler is required to ensure that the core tube remains in the closed position. As the sampler is dislodged from the sediment, the sampler is retrieved in such a way that the cover plate is above the core tube. As a result, gravity pulls down on the cover plate, further ensuring that the core tube remains in the closed position. After sampler retrieval, the core tube is then manually turned counterclockwise, rotating the tube and exposing the semicylindrical core sample on the cover plate.

To allow consecutive, complete reconstruction of a long sediment profile, two Russian Peat Borers can be alternately deployed side-by-side to alternating depths. This procedure allows continuous core samples to be collected sequentially, with one sampler remaining in the sediment as a sample is collected using the other sampler. This procedure is designed to minimize disturbance of the sediment while ensuring that a complete, continuous sediment core is collected.

2.3 Advantages and Limitations

An advantage of the Russian Peat Borer is that it is easy to operate, requiring minimal skills and training. Although ARI currently does not have a training video or written standard operating procedure (SOP), sampler assembly and collection procedures can be learned in the field with a few practice attempts. The sampler can be operated by one person because of its lightness (see Table 2-1). Sampler operation is simple because it has only one moving part (the core tube rotates 180 degrees). Moreover, the sampler does not require disassembly to extrude the sample and reassembly after each sampling attempt. The sampler requires no support equipment other than two sawhorses for supporting the sampler during sample extrusion, a slide-hammer mechanism, and a safe sampling platform.

The Russian Peat Borer also has the unique ability to collect discrete, relatively uncompressed core samples from shallow to deep depth intervals without disturbing the sediment stratification. In addition, when only deep core samples are required, the amount of investigation-derived waste (IDW) generated is minimized because the Russian Peat Borer is a discrete sampler.

A limitation of the Russian Peat Borer is that the sampler is not equipped with disposable core liners. During sampler deployment, the cover plate is exposed to different layers of sediment contamination. Contaminants may adhere to the exposed surface of the cover plate while the sampler passes through different layers of sediment, increasing the risk of cross-contamination between sampling depth intervals. Another limitation of the Russian Peat Borer is that during sampling, partially decomposed plant matter or small stones may become caught between the core tube and the cover plate, causing the core tube to remain in the open position during sampler retrieval and resulting in sediment washout. Furthermore, collection of a sediment sample using the sampler requires that the sediment offer enough resistance (support) to keep the cover plate stationary and allow rotation of the core tube.

2.4 Developer Contact Information

Additional information about the Russian Peat Borer can be obtained from the following source:

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