Computers (Richmond, USA). They could be programmed to send off a certain number of transmissions per day, only transmitting on certain hours, days and months during the deployment period and when the water switch was dry. Details of the system are given in (www. Wildlifecomputers.com).The SPOT 2 (mainly used during MINOS) weighed 85 g (110 x 32 x 15 mm) (Fig. 7) and was powered by a 3 V M3 Lithium battery, whereas the SPOT 3 (mainly used during MINOS+) weighed 45 g (48 x 42 x 14 mm) (Fig. 8) and was powered by a 3 V M1 Lithium battery.

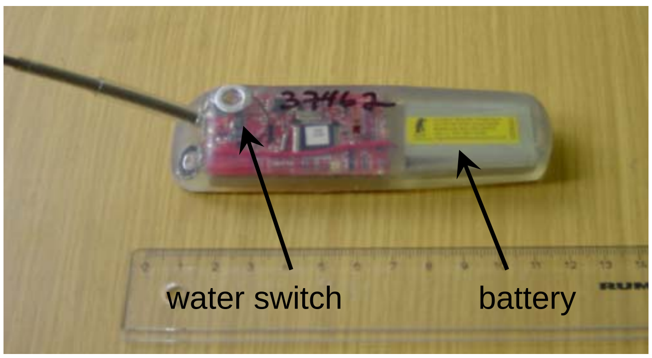

Figure 7. The satellite transmitter (PTT) SPOT2-tag from Wildlife Computers.

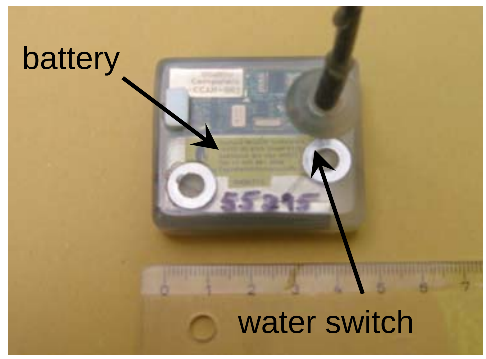

Figure 8. The satellite transmitter (PTT) SPOT3-tag from Wildlife Computers.

2.2.3 The IMASEN (Inter-mandibular Angle Sensor)

In this study, two different versions of the IMASEN (Driesen und Kern GmbH, Bad Bramstedt, Germany) were deployed. On the harbour seals, a resin-embedded single channel logger with 8 MB flash RAM, 16 bit resolution, with maximum dimensions of 73 x 33 x 19 mm and a weight of 35 g in air (Fig. 9) was used. The Hall sensor (6 x 3 x 2 mm, KSY 10, Siemens GmbH, Germany) was also coated in resin and connected to the logger by a 4-strand

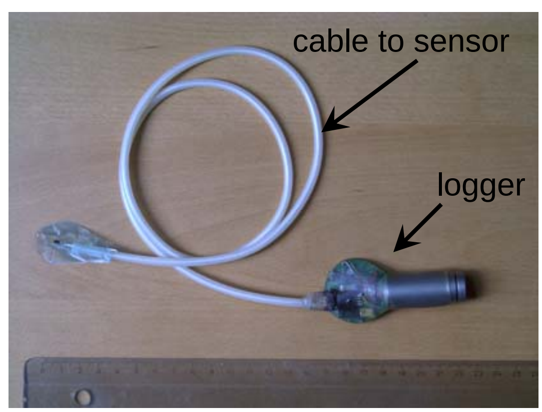

Figure 9. The in resin embedded Inter-Mandibular Angle Sensor (IMASEN) used on the harbour seals, showing the cable linking the Hall sensor to the logging unit.

cable and a plug (see Wilson et al., 2002 and later for details).

On the Weddell seals, a slightly different version was used where the circuit board and battery were housed in a titanium cylinder (140 x 20 mm) with the cable exiting at one end via an O-ring seal. The cylinder was filled with silicon oil to negate problems with hydrostatic pressure on air spaces via a special, O-ring-sealed opening. The logger had a 16 MB flash memory, 16 bit resolution and a weight in air of 86 g (Fig. 10). The cable and sensor were identical to the one described above.

Both IMASEN units could be set to sample at frequencies of up to 30 Hz. The Hall sensor produced an output proportional to magnetic field strength intensity so that the proximity of a magnet could be well defined. In my application, a slightly-bent neodinium boron magnet (30 x 25 x 3 mm, Vacuumschmelze GmbH and Co, Hanau, Germany) was placed under the seal's lower jaw, behind the mandibular symphysis while the Hall sensor was placed on top of the upper mandible, behind the nose (Fig. 10) so that, after suitable calibration, jaw angle could be determined to allow examination of feeding behaviour (see Liebsch, 2002; Simeone & Wilson, 2003; Wilson et al., 2002). The accuracy of the system depended critically on the placement of the magnet with respect to the sensor, but resolution of seal jaw angle to within 3 degrees was typical.

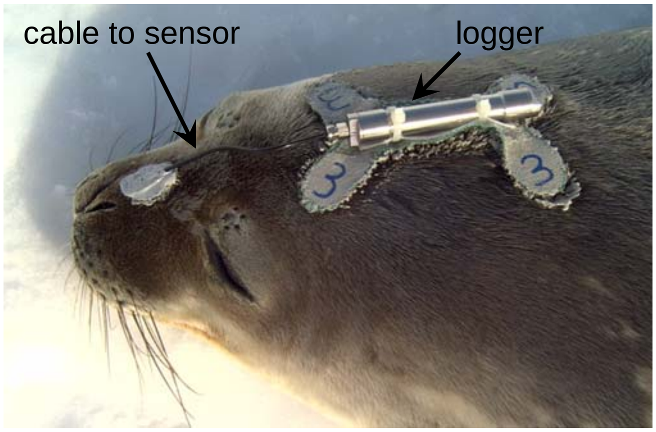

Figure 10. The titanium-housed Inter-Mandibular Angle Sensor (IMASEN) deployed on a Weddell seal.