

Short communication

Dimensions for colour rings

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The comprehensive paper by Ward (2000) on the production and use of colour-rings (or colour-bands) made from Darvic (manufactured by Wardle Storey, UK) prompted us to consider the size and manufacture of colour-rings in use by British Trust for Ornithology (BTO) and University of East Anglia (UEA) staff and students. In doing so we felt it would be useful to establish generic methods for calculating both the length of Darvic strip required to make a ring and the diameter of the hole in the "former" used to shape it.

Darvic rings may be butted or, to prevent their loss on species such as waders or gulls that live in harsh environments, overlapped. In overlapped rings, the degree of overlap necessary to prevent loss varies with size. For small rings (up to BTO metal ring size E – internal diameter 7 mm) we have found that an overlap of 0.5 to 0.75 turns (a total of 1.5 to 1.75 turns) works well. Larger rings may require a greater overlap.

Larger colour rings (BTO metal ring size F (ID 9 mm) and above) are suitable for engraving with unique numbers or letters that can easily be read in the field and have the advantage of providing an individual identifier in one ring. Engraved rings usually have a small overlap (approximately a quarter turn) and should always be "glued" using a solvent cement.

Darvic rings are shaped in a "former" made from a block of metal or other heat-resistant material (aluminium is ideal as it heats and cools rapidly), the thickness of which is the height of the finished rings. The former is drilled with holes of the correct size for the external diameter of the finished ring. In order to make colour-rings, the diameter of the holes to be made in the former and the dimensions of the strip of Darvic to be used have to be calculated and tested. The final internal diameter of the fitted ring should be comparable to that specified for the metal ring size for the species. The ring should not be so loose as to risk becoming lodged over the "knee" or "ankle", nor so tight that it cannot move freely up and down the leg and rotate. Note that if the internal diameter is for rings placed on the tarsus (i.e. below the "knee"), rings placed on the tibia (i.e. above the "knee") may need to be slightly larger than the size specified as the tibia may be a little thicker than the tarsus. It should also be noted that the tibia of some species may increase in size during the breeding season. Care should be taken to ensure that rings placed on the tibia cannot slip over the intertarsal ("knee") joint.

The diameter of holes in the former

To make overlapping rings, the diameter of the holes required for the ring former (D) can be calculated from:

$$D = I + 4T$$

Where I is the internal diameter of the finished ring (mm) and T is the thickness of Darvic being used (mm). Thus, for a finished ring with an internal diameter of 5.25 mm (equiva-

lent to BTO metal size D), made with 0.5 mm Darvic and an overlap of 0.75 turns (a total of 1.75 turns) the required diameter of the holes in the former will be:

$$D = 5.25 + (4 * 0.5) = 7.25 \text{ mm}$$

We would recommend that all colour rings, and particularly tall rings which are more difficult to apply to a bird's leg, should not have an overlap of more than 0.75 turns. However, if a bigger overlap is used the calculation will be as follows:

$$D = I + T (2R_{\max})$$

Where R_{\max} is the maximum number of layers of Darvic in the finished ring.

The length of Darvic required

Similarly, the length of Darvic strip (L) required for a ring of a given diameter can be calculated from:

$$L = (I + T (2R_{\max})) \pi V$$

Where V is the number of turns of Darvic in the finished ring. Thus, for the above finished ring with an internal diameter of 5.25 mm, made with 0.5 mm Darvic and an overlap of 0.75 turns (total of 1.75 turns), the length required would be:

$$L = (5.25 + (0.5 * 4)) * \pi * 1.75 \approx 40 \text{ mm.}$$

Note that there is some tolerance in the thickness of Darvic supplied; different supplies of 0.5 mm Darvic have been found to vary from 0.4 mm to 0.6 mm. Before embarking on a production run of rings, a single hole should be made in a former and tests carried out to ensure the completed colour-rings have the correct internal diameter and amount of overlap.

The height of Darvic required

For rings with an internal diameter of up to 9.0 mm, the International Wader Study Group recommends the use of either short or tall colour-rings. Short rings are the height of the equivalent BTO metal ring and tall rings are double that height (Ward 2000). Thus a short colour-ring for a Grey Plover *Pluvialis squatarola* (BTO metal ring size D) would be 7 mm and a tall ring 14 mm. Note that tall rings will not be suitable for species with short tarsi. Proportionately taller rings have been suggested for species taking a larger ring size (Mitchell, Fox & Madsen 1996).

Mitchell, C., Fox, A. & Madsen, J. 1996. Promoting wise use of individual marking techniques. *Wetlands International Goose Specialist Group Bull.* 8: 5–6.

Ward, R. M. 2000. Darvic colour-rings for shorebird studies: manufacture, application and durability. *Wader Study Group Bull.* 91: 30–34.

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