recovery – the bird making the effort to fly off. The presence of other normal birds being released and flying away near cramped birds seems to encourage the recovery process.

Some conclusions

One can conclude from these notes that waders prone to capture myopathy (Curlew, Whimbrels *Numenius phaeopus*, Bar-tailed Godwits and perhaps certain other long-legged species) must be extracted from the net (cannon or mist) in which they are captured as rapidly as possible and transferred to tall (so the birds can stand) hessian (or similar cloth) cages where the light is subdued but not so dark that the birds crouch. If the extraction time from a cannon net is to exceed a few minutes the catch must be covered immediately with lightweight dark cloth which subdues the birds and reduces their efforts (straining and struggling) to escape. Also generally, but particularly if birds are showing signs of cramp, release should be considered as an important part of the ringing process and should not be left to an unsupervised inexperienced member of the team.

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Possible capture myopathy in Bar-tailed Godwits *Limosa lapponica* in Australia

D. PURCHASE[1] & C.D.T. MINTON[2]

[1]*Division of Wildlife Research, CSIRO, PO Box 84, Lyneham, A.C.T. 2602, Australia*
[2]*45 Bodenham Road, Hereford, UK*

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Capture myopathy is a condition associated with stress which occurs in many mammals and some species of birds (especially those with long legs) following their capture. The most obvious symptom is paralysis of the limbs, particularly the legs. Birds affected by capture myopathy also seem unable, or unwilling, to fly. In recent years three notes have been published in the *Bulletin* about capture myopathy in long-legged waders in Britain (Green 1978, 1980, Stanyard 1979). In Australia, with an increase in the numbers of Bar-tailed Godwits *Limosa lapponica* and other long-legged waders being banded, capture myopathy has now shown itself to be a problem. A previous incident in Australia involving capture myopathy has already been reported (Minton 1980). This notes provides details of another incident in Australia involving possible capture myopathy in Bar-tailed Godwits.

During 19 and 20 March 1981, a group of about 20 banders, including the authors, visited Botany Bay, New South Wales. Botany Bay, 20 km south of Sydney, is roughly circular with a diameter of approximately 8 km. About half the shoreline comprises sandy beaches fronting suburban (including industrial) areas, and the other half mangroves and mudflats.

On 19 March 1981 two cannon nets (each about 28 × 13 m in size) were fired at 07.30 hrs on a rising tide on a sandy beach at the northern end of Botany Bay. The weather was fine. The temperature was about 18°C and rising. Twenty-four Bar-tailed Godwits and one Lesser Golden Plover *Pluvialis dominica* were caught. Some birds were trapped under the front portion of the net which landed in the sea, but the net and birds were quickly moved to the shore. The birds in the net were then covered with large sheets of cloth or hessian. When this had been done, the birds were removed and placed in holding cages about 1 m high. All the birds were then processed (banded, measured and examined for moult).

Immediately after each bird was processed it was released by placing it on the sand in a quiet area about 40 m from the processing site. On release, eight of the Bar-tailed Godwits showed some paralysis of the legs. However, they all seemed to recover and fly away. About 1.5 hours elapsed between when the net was fired and the last Bar-tailed Godwit was released.

Later on 19 March one cannon net was fired at 18.30 hrs (a few minutes before sunset) on a rising tide on a sandy spit at Towra (about 7 km across the bay from the previous banding site). The weather was fine, although a cool wind was blowing. The temperature was about 15°C and falling. The front portion of the net landed on a number of birds in the

Table 1. Reports of Bar-tailed Godwits ringed on 20 March 1981.

Ring no.	Date of finding	Condition and location
*082-43939	20.3.81	"sick"; Botany Bay (exact site unknown)
082-44028	21.3.81	"large wound to the neck, and injured left leg and could not fly"; Towra Point, Botany Bay
082-44017	21.3.81	"dead"; Towra Point, Botany Bay
*082-44031	22.3.81	"unable to stand or fly"; Brighton-le-Sands, Botany Bay
082-43935	22.3.81	"wounded"; beach on the north-eastern shore of Botany Bay
*082-43964	29.3.81	"unable to walk"; Botany Bay (exact site unknown)

sea, but the net and the birds were quickly moved to the shore. Fifty-three Bar-tailed Godwits and about 25 Silver Gulls *Larus novaehollandiae* were caught. The catch was handled in the same manner as the morning's catch. The last bird was released about 1 hour after the net was fired. Only five of the Bar-tailed Godwits showed any sign of paralysis of the legs.

On the next morning, 20 March 1981, one of the cannon nets was fired at 08.30 hrs on a rising tide on a sandy beach on the north-eastern side of Botany Bay. This site was about 3 km along a beach from the previous morning's banding site and about 6 km across the bay from the previous evening's banding site. The weather was fine and the temperature was about 20°C and rising. Again the front portion of the net landed on a number of birds in the sea, but the net and birds were quickly moved to the shore. One hundred and seventeen Bar-tailed Godwits (including nine which had been banded on the previous day), one Black-tailed Godwit *L. limosa*, and 112 waders of seven other species, were caught. The catch was handled in the same manner as on the two previous occasions. In view of experience elsewhere that godwits may suffer capture myopathy, they were removed from the net and placed in holding cages before any other species. When all the birds had been removed from the net and placed in holding cages, the godwits were processed first. After each godwit was processed, it was released in a quiet spot away from, and out of sight of, the processing site. The last godwit was released about 1.5 hours after the net was fired. The other waders were then processed and released (by allowing them to fly from a person's hand) without any complications. About 25 of the Bar-tailed Godwits had shown signs of paralysis on release, but all appeared to have recovered and flown away by the time the banding team left the site at 11.30 hrs on 20 March.

At 14.30 hrs on 20 March a report was received by the office of the Australian Bird-Banding Scheme at the CSIRO in Canberra of a banded Bar-tailed Godwit which had been found "sick and unable to fly" in the Botany Bay area. (Because the report was third-hand it has not been possible to establish exactly where in Botany Bay the bird was found). This bird was one of the 117 Bar-tailed Godwits which had been caught that morning. It was subsequently taken to Tatonga Zoo in Sydney where it was cared for.

During the next 25 days another five banded Bar-tailed Godwits were found in the Botany Bay area. One of these was dead and four were incapacitated (Table 1). Like the first bird, all had been banded on the morning of 20 March. Although there is no conclusive evidence that the three birds which were not taken to the zoo had been affected by capture myopathy (two were reported as being "wounded" and one as being dead) it is felt that this was probably the case.

There are five notable points about the birds which were found:

1. All were from the 108 birds newly-banded on the morning of 20 March. It is not known if any were among the 25 birds which showed temporary paralysis on release after banding. Although 77 birds were banded at the other two sites, none of these birds were reported to have been dead or incapacitated.

2. All were adult females, despite the number of males and females banded being almost equal – 54 adult males, 47 adult females, and seven juveniles on 20 March, and 30 adult males, 40 adult females and seven juveniles, on 19 March.

3. From their appearance and weight most of them were carrying much subcutaneous fat when they were banded. Weights at banding were 390 g, 465 g, 525 g and 555 g. The average weight of a female Bar-tailed Godwit in Australia prior to its accumulation of fat in preparation for migration is about 350 g.

4. At least three of the birds had travelled some distance from there they were banded; two were found 6 km across Botany Bay and one was found 5 km across Botany Bay from the place of banding. This indicates that, between when they were banded and found, the birds were able to fly.

5. One bird was found "unable to walk" nine days after it was banded. It seems unlikely that this bird would have survived had it been unable to walk for nine days, so it seems more likely that the bird's incapacity developed some time after it was captured and released.

Those birds indicated by an asterisk (*) were taken to Taronga Zoo. All eventually died and the post-mortem findings were consistent with them having died from possible post-capture myopathy.

In view of the indication that large amounts of subcutaneous fat may increase the risk of capture myopathy, we examined the weights of the nine adult Bar-tailed Godwits which had been banded on 19 March and recaptured on the morning of 20 March. Weights were measured with Pesola spring balances which had been checked for accuracy. As can be seen from Table 2, each of these birds lost weight between banding and recapture.

The mean weights of each of the three catches of adult Bar-tailed Godwits are shown in Table 3. We have excluded from these samples fourteen males and seven females which

Table 2. Weight changes of Bar-tailed Godwits on 19 and 20 March 1981:

a. banded a.m. 19.3.91 and recaptured a.m. 20.3.81 (3 km away).

Band no.	Age & sex	Weight at banding (g)	Weight at recapture (g)	Loss (g)
082-43857	Adult Male	435	390	45 (10.3%)
082-43861	Adult Male	380	330	50 (13.2%)
082-43865	Adult Male	460	435	25 (5.4%)
082-43874	Adult Male	420	405	15 (3.6%)
082-43865	Adult Female	365	350	15 (4.1%)
082-43873	Adult Female	535	455	15 (4.1%)

b. banded p.m. 19.3.81 and recaptured a.m. 20.3.81 (6 km away).

Band no.	Age & sex	Weight at banding (g)	Weight at recapture (g)	Loss (g)
082-43883	Adult Male	295	245	50 (16.9%)
082-43890	Adult Female	450	380	70 (15.6%)
082-43915	Adult Female	530	510	20 (3.8%)

Table 3. Weights of Bar-tailed Godwits on 19 and 20 March 1981

	n	mean (g)	Standard deviation
Adult males			
19.3.81 a.m.	13	424.2	26.1
19.3.81 p.m.	14	432.5	37.7
20.3.81 a.m.	42	412.8	36.9
Adult females			
19.3.81 a.m.	7	527.9	18.5
19.3.81 p.m.	30	528.0	37.7
20.3.81 a.m.	43	511.7	35.9

Table 4. Weights of Bar-tailed Godwits on 2 September 1981.

	n	mean (g)	Standard deviation
Adult males	29	246.8	18.7
Adult females	13	286.7	31.0
1st-year males	37	250.4	18.5
1st-year females	18	304.3	25.4

were still in wing moult, three males which were exceptional heavy (510g, 565g and 580g), possibly because of a recording error (e.g. they may have been females which were incorrectly recorded as being males), and the nine birds recaptured on the morning of 20.3.81.

There were no significant differences (t-tests) between the means of the samples within each sex.

Therefore it appears that the losses of weight after banding are not related to any weight changes in the population as a whole. Thompson (1974) describes a similar loss of weight after banding in Ruddy Turnstones *Arenaria interpres*.

On 2 September 1981, at 13.00 hrs, a cannon net (a little smaller in size than those which had been used at Botany Bay in March) was fired over a group of waders on a sandy beach 5 km east of Broome in Western Australia by a group of people which included one of the authors (CDTM). The weather was fine and the temperature was about 28°C and rising. Ninty-seven Bar-tailed Godwits, and 216 waders of 11 other species were caught. The catch was handled in the same manner as the catches at Botany Bay. All the Bar-tailed Godwits were measured and examined for moult. On release, only two of them showed any hesitation in flying away, and even those flew away after resting for a few minutes.

It is worth noting that, compared with Botany Bay, the temperature when the birds were caught was considerably higher, and more birds were caught together. This suggests that high temperature and the simultaneous capture of large numbers of birds may not, in themselves, be major contributing factors in the occurrence of capture myopathy in Bar-tailed Godwits.

The Bar-tailed Godwits captured at Broome were light (Table 4).

It is probable that the adults had recently arrived in Australia from their breeding places in the northern hemisphere, and that the 1st-year birds had been present (many of them moulting) in Australia throughout the winter.

The fact that the Bar-tailed Godwits were light and all but two immediately flew away on release supports the suggestion that adult females carrying a lot of fat are those most likely to be affected by capture myopathy.

We conclude that:

1. Adult females, particularly those carrying a lot of subcutaneous fat, are more likely to be affected by capture myopathy than adult males or juveniles.

2. The risk of capture myopathy may be increased when large number of birds are caught together. (The capture of a large number of birds would, through crowding, increase the stress that the birds are subject to under the net and also increase the length of time that they spend under the net or in holding cages).

3. The risk of capture myopathy may be increased if the temperature is relatively high at the time when the birds are captured and held in captivity. (Note also that some previous studies imply that cold temperature may also have an effect).

4. The main symptom of capture myopathy, an inability to walk or fly, may not always become apparent immediately after the birds are released.

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Leg 'cramp' and endoparasites

DAVID S. MELVILLE

c/o 44 The Ridgeway, Tonbridge, Kent TN10 4NJ, UK

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The causes of leg 'cramp' in waders are not fully understood (*Wader Study Group Bull.* 24: 24; 27: 19–21; 28: 15–16). Stanyard (*Wader Study Group Bull.* 27: 19–21) reported that the three casualties out of 110 Curlews *Numenius arquata* caught were in a less advanced state of moult than the other birds and noted that 'this might indicate poorer condition'. However, Purchase and Minton (*Wader Study Group Bull.* 34: 24–26) found that female Bar-tailed Godwits *Limosa lapponica* with much subcutaneous fat (i.e. in 'good' condition) seemed more likely to suffer from 'cramp' than males or juveniles.

During the winter of 1980/81, a total of 256 Redshanks *Tringa totanus* were caught at night in mist nets in central Thailand. Of these, nine suffered from 'cramp', despite being placed in tall keeping boxes (*Wader Study Group Bull.* 20: 21–24) after capture, and were killed. A further four apparently healthy birds were also collected (two caught by the author and two from local bird nets. Of the latter, one was found freshly dead, and the other alive but with a dislocated leg). All specimens were prepared as museum skins. Brief examination of the carcasses revealed that five of the nine 'cramp' victims had some endoparasites (nematodes, cestodes, trematodes), and in several cases the burdens were heavy. None of the four healthy birds showed signs of endoparasite infections. (All parasites are awaiting identification). It is therefore possible that waders with endoparasite burdens and so possibly in poor condition, may be more liable to 'cramp' than waders in better condition. To further examine the possibility of a link between endoparasite burden and leg 'cramp', it would be useful if those people with access to 'cramp' victims examine them for endoparasites as well as determining general body condition.

Valium against leg cramp in waders

THEUNIS PIERSMA[1], ANNE-MARIE BLOMERT[2] & MARCEL KLAASSEN[3]

[1]Netherlands Institute for Sea Research (NIOZ), PO Box 597, 1790 AB Den Burg, Texel, and Zoological Laboratory, University of Groningen, PO Box 14, 9750 AA Haren, The Netherlands
[2]Zoological Laboratory, University of Groningen, and Foundation Working Group for International Wader and Waterfowl Research (WIWO), c/o Driebergsewag 16c, 3708 JB Zeist, The Netherlands
[3]Research Institute for Nature Management (RIN), PO Box 9201, 6800 HB Arnhem, and WIWO, The Netherlands

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On five different occasions Knots *Calidris canutus* and Oystercatchers *Haematopus ostralegus* suffering from leg cramp were successfully treated with valium (diazepam). They recovered, in several cases after a period of deep sleep. Although valium was applied on only two wader species, we suspect that it may generally be applicable. We suggest that valium-tablets (of e.g. 1 mg) are henceforth at hand during catching operations to try to treat any victims of leg cramp.