

Assyrian Percentages? Calculating the Birth-rate at Dur-katlimmu

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It is one of the delights of being an Assyriologist that new pastures are constantly opening up before us, and some of the juiciest grazing in recent years has come from the Middle Assyrian archives of Dur-katlimmu which shed detailed light on all sorts of matters Assyrian. Mario Fales has already given us his take on these texts in his article on “production and consumption at Dūr-katlimmu” (Fales 2010), and I welcome the chance to join him once again by addressing the technical procedures of the Assyrian Department of Animal Husbandry in the 13th century BC.

A number of annual accounting texts setting out the relationship between shepherds and the state owner of their flocks were published by W. Röllig in his magnificent edition (Röllig 2008). By comparison with other herding regimes known to us in Mesopotamia, it would be reasonable to assume that the annual stock-take gave the owner of the animals the opportunity to hold the herdsmen to account for their performance over the previous year and to determine the level of their obligation for the year to come.¹ In both the state and private sector it was common practice for the owners to require an annual amount of wool and a number of newly born animals from the shepherd, in line with accepted ratios of wool: wool-bearing animal and lambs: adult females. From the state records of Old Babylonian Larsa we learn that “the shepherds were allowed a 15 per cent natural loss on the adult ewes, to be offset against an expected 80 per cent birth rate ...”, and “two minas, or about 1 kg, of wool was expected from each animal”.² If it had been a good year, and the flock had exceeded the 80% expectation, the shepherd stood to profit in person; but he was also liable for any shortfall, whether in the amount of wool, or the number of surviving adult animals or new-born lambs. At Nuzi, much closer in time and place to Dur-katlimmu, Morrison writes that “practices governing the contractual relationship between the herdsmen and the livestock owners at Nuzi were similar to those of the Old Babylonian period. Herdsmen were expected to return the livestock to the owner at the *buqūnu* [shearing]. Livestock that died or were lost while in the herds-

1 For a succinct description of earlier herding relationships cf. Postgate 1992: 159–161, and note that at Old Babylonian Larsa, as here, the sheep and the cattle were recorded by the same office (*ibid.*: 164).

2 Postgate 1992: 161.

man's care were to be repaid. ... Further, the practice of producing the skins of dead animals to prove losses seems to have been followed".³

It is reasonable to expect similar arrangements to have operated at Dur-katlimmu, but since most of the annual herd and flock lists do no more than list the live animals in the keeping of each herdsman at one moment in the year, not infrequently the 20th of Ībur, giving the numbers of different ages and sexes, they have nothing to say about changes from year to year or the mutual relationship between the state and the herdsman. This information is gathered in a different and less transparent type of accounting text, no doubt often on the same day, since some of these texts also are dated to the 20th Ībur. These tablets are termed by Röllig "Rapporte über die Erträge der Herden", and could be called "yield statements". They present information about diminutions of the herd, whether through deaths attested by the delivery of skins, or from issues on the instructions of the state, or some other reason, and on the growth of the herd expressed through the birth-rate (*tālittu*), and thus they make a statement about both the past performance and the future obligation of the individual herdsman or shepherd – reports on the yield of the herds.⁴ As he notes, most of the entries are introduced by the word *ištu* ..., "After ...", and it is easiest to begin by illustrating this with an example.

Röllig 2008 No. 39

<i>iš-tu</i> 1 GU ₄ - <i>šu a-na</i> ŠE.IÀ.[GI]Š <i>a-na a-ra-še a-na</i> ¹ <i>be-ru-ti-ia</i> <i>ta-ad-nu-ni</i>	After 1 ox of his had been issued to Berutiya for cultivating sesame;
11 GU ₄ - <i>šu NÍTA a-na</i> GAL.MEŠ LÚ.ENGAR.MEŠ <i>ta-ad-nu-ú-ni</i> <i>im-ḥu-ru-ni</i>	11 male oxen of his had been issued to the Farm Overseers,
1 KUŠ GU ₄ .ĀB GAL- <i>te</i> <i>a-na</i> LÚ.ASGAB <i>a-na</i> GIŠ.GĀR GIŠ.GIGIR <i>ta-ad-nu-ni</i>	1 hide of an adult cow had been issued to the leatherworker for the work-assignment of a chariot;
1 GU ₄ - <i>šu</i> <i>a-na</i> ^{utu} <i>tu-tu-ul</i> <i>a-na ra-da-e ta-din</i>	1 ox of his was issued to be driven to Tuttul;
NÍG.KA ₉ .MEŠ- <i>šu šal-mu</i> 1 <i>šu-ši.TA.ĀM ta-li-tu-šu</i> <i>a-na</i> 80.TA.ĀM <i>ta-li-te</i> 2 GU ₄ <i>mu-ru ma-ṭi-ú</i>	his accounts were finalized. His birth-rate is at 60, for a birth-rate at 80 2 calves are lacking.

³ Morrison 1981: 270f.

⁴ No. 34 unusually combines both statements on a single tablet, giving first the herd and flock numbers for cattle, donkeys and sheep+goats, and then in the same order their annual yield statements introduced by *ištu*.

<i>ša-bat</i> NÍG.KA ₉ .MEŠ <i>ša</i> ¹ 10–MU-KAM	Accounts audit of Adad-šuma-ereš
LÚ.SIPA GU ₄ .MEŠ	the ox-herd.
ITI <i>a-bu</i> –LUGAL.MEŠ	Month of Abu-šarrani,
UD.20.KÁM <i>li-mu</i>	20th day, eponymate of
^{1.d} <i>na-bi-um</i> –EN–PAB	Nabu-bel-ušur.

Abu-šarrani is the month before Ḫibur, and this is no doubt part of the annual accounting process in which the relationship between the ox-herd and the state is regulated. We have to assume that in drawing up this document the two parties had before them agreed numbers for the current composition of the herd, and also a knowledge of the comparable figures for the previous year, although neither set of figures is repeated here. As in other Mesopotamian cases where the liabilities of shepherds towards the private or institutional owners of the flocks or herds are adjusted, the text does however list animals which had been extracted from the herd on the instructions of the state, and for which the herdsman was therefore no longer held responsible (in Old Babylonian, *zi.ga = šītum*).⁵ It also lists an ox-hide which had been passed to a leatherworker who was working on a chariot, presumably for the state. There were also deaths and losses to be accounted for: in No. 22 we read that 75 donkeys had been handed over to Tukulti-Adad on the instructions of the Governor for pasturing (*a-na ra-'a-e*), and that “he will fully (replace) the lost and the dead” (*ḫalqa u mēta umalla*). However, it was accepted that some deaths would occur naturally, and in this case the herdsman could escape at least some liability by bringing the skins of the dead animals, which were both intrinsically of value but also constituted evidence that the animals had not been sold or otherwise disposed of. Hence most annual liability statements are formulated differently and may include a number of hides (or sheepskins) which are to be deducted (*karrū*) from the total for which the herdsman is liable. No. 40 is an example of this.

Röllig 2008, No. 40: 9–19

<i>iš-tu</i> 3 KUŠ ANŠE.EME ₅ GAL	After 3 skins of adult female donkeys,
1 KUŠ EME ₅ MU.2	1 skin of a 2-year-old female donkey,
1 KUŠ EME ₅ <i>pír-si</i>	1 skin of a weaned female donkey,
1 KUŠ ANŠE MU.4	1 skin of a 4-year-old male donkey,
2 KUŠ ANŠE.MEŠ <i>pír-si</i>	2 skins of weaned male donkeys,
ŠU.NÍGIN 8 KUŠ-šu	– Total 8 skins of his
<i>i+na</i> UGU-šu	have been deducted from his liability.
<i>kar-ru-ú</i>	
NÍG.KA ₉ -šu <i>šal-mu</i>	His accounts are finalized.
40.TA.ĀM <i>ta-li-tu-šu</i>	His birth(-rate) is at 40.
^{1.d} IM–DI.KUD SIPA ANŠE	Adad-da'an, donkey herd.

5 Compare similar entries in the Tell Ali texts (e.g. Ismail & Postgate 2008: Nos. 7; 8; 11).

This text seems straightforward: it sounds as though he has produced these 8 skins and he has accordingly been exonerated from liability for these animals. However, other texts indicate that the usual procedure was more elaborate. No. 56 lists a similar variety of sheep and goat skins, and then states:

Röllig 2008, No. 56: 5–8

ŠU.NÍGIN 35 KUŠ.MEŠ <i>ša še-ni sa-mu-ḥa-te</i>	Total: 35 skins of mixed flocks.
<i>i-na</i> 1 ME 10 KUŠ.MEŠ <i>na-aš-šu</i>	In 100 10 skins have been brought.
22 UDU.NÍTA.MEŠ <i>a-na É.GAL-lim ta-ad-nu</i>	22 wethers have been issued to the palace.
<i>i-na</i> UGU-ŠU <i>kar-ru-ú</i>	They have been deducted from his liability.

That the shepherd should have supplied 22 male sheep to the palace, and is not to be held liable for them, is entirely in accordance with our expectations – it was regularly the males which were dispensable in the composition of the flocks. The difficulty is with the second line quoted here. Like the annual liability statements, it does not give us the actual figures for the animals, merely a basis for numerical calculation; to be understood, it has to be treated alongside a number of similar entries, e.g.

Röllig 2008, No. 51:10–12

ŠU.NÍGIN 46 KUŠ.MEŠ <i>i-na</i> 1 ME 7 KUŠ.MEŠ	Total: 46 skins. In 100 7 skins have been
<i>na-šu a-na É.GAL-lim</i>	brought. He shall bring (them) to the palace.
<i>ú-bal še-ni i-na</i> UGU-ŠU <i>ú-kar-ru-ú</i>	They will deduct the animals from his liability.

The other examples are similar:

No. 21: 9–10	<i>iš-tu a-na</i> 1 ME- <i>te</i> 7 KUŠ.MEŠ <i>i-na</i> UGU-ŠU <i>kar-ru-ú-ni</i>
No. 28: 13	<i>i-na</i> 1 ME- <i>te</i> 7 KUŠ.MEŠ <i>i-na</i> UGU-ŠU <i>kar-ru-ú</i>
No. 35: 4–7	[ŠU.NÍGIN <i>n</i> KUŠ.MEŠ]Š <i>i-na</i> ME- <i>te</i> [<i>n</i> KUŠ.MEŠ [<i>n</i>]a- <i>šu</i>
No. 52: 6–7	ŠU.NÍGIN 10 KUŠ.MEŠ <i>i-na</i> 1 ME- <i>te</i> 7 KUŠ.MEŠ <i>na-šu</i>
No. 53: 4	ŠU.NÍGIN 5 KUŠ.MEŠ <i>i-na</i> 1 ME- <i>te</i> <i>na-šu</i>
No. 53: 10	[ŠU.NÍGIN] 6 ³ K[UŠ].MEŠ <i>i-na</i> 1 ME- <i>te</i>
No. 53: 18	ŠU.NÍGIN 7 KUŠ.MEŠ <i>i-na</i> 1 ME- <i>te</i> <i>na-šu</i>

In his edition, Röllig considers, but rejects, the possibility that the word we have here is *mēte*, “100”, and opts instead for *mētū*, “dead”, and suggests (following a suggestion from Freydank) that the phrase means that by delivering 7 (or another number of) skins, the shepherd earned the value of one dead animal.⁶ However, in favour of “100” rather than “dead” is the fact that in not one but two instances (Nos. 51 and 56) the scribe has written simply 1 ME: ME is obviously an acceptable logographic writing for *mēte*, but to make these two passages say “dead” does indeed require

⁶ Röllig 2008: 52 on No. 21: 9f. Note that the writing 1 ME (without *-te*) is also found in No. 56; and that we should have the *status rectus* of 100, here written *me-te* (and not *meat* or similar in *status absolutus*), is entirely in accord with this context, where the meaning is “in a hundred”.

emendation of the text as proposed by Röllig (1 *me<-te>*), which is something always to be avoided if possible, and all the more where it occurs more than once.⁷ Moreover to express the meaning “in place of” we would expect Middle Assyrian texts to use *kīmū*, “instead of”, rather than *ina* or *ana*, which do not convey the idea of substitution. More generally, on his interpretation one must wonder why the shepherd should only ever be providing enough skins to substitute for one single animal. Rather it is clear that we are looking at an early case of accountants using percentages: we should understand No. 51 (year 32⁸) as meaning that the shepherd brought 46 skins in total, and that these constitute 7 skins per each 100 animals in his flock, which therefore must have numbered approximately 657. This figure is in line with Erib-Sin’s holdings as listed in Nos. 27 (646; year 28) and 30 (602; undated). No. 56 (above; undated) suggests a total of 350 animals in Erib-Sin’s flock⁹ – it may be earlier, therefore. Likewise in No. 52 (year 34) the 10 skins supplied by Šilli-Adad would correspond at 7 in 100 to a total of about 140, and this is quite possible since in No. 23 (year 27) his herd numbers 131, and in No. 22 (year 36) we see that he had been holding as many as 150 donkeys (here divided between him and Tukulti-Adad). In the other texts the absolute number of skins brought (and then transported to the palace) is not specified, and we are not told the total number of the annual count. Here the texts are setting out the proportion of skins to live animals used for calculating the herdsmen’s annual liability and we have to assume that the calculations were made orally, or recorded on a different tablet. The figure 7 recurs in at least 5 of the 9 cases, and this rather suggests that 7% was an accepted norm for permissible deaths over the year, but that the shepherds would not be credited with this if they did not supply the evidence of death in the form of the skin.

It is not apparent what would have happened normally when more than 7% had died, but there were circumstances in which the shepherds could be exonerated for excessive losses. One such situation is reflected for the flock of Adad-le’i:

Röllig 2008, No. 48: 22–27

ŠU.NÍGIN 276 *še-ni a-na* SAG.DU
um-ta-ṭí ma-a i+na KIN *me-il-te me-e-ta*

Total: 276 flocks he underprovided for the capital saying “They are dead from the action of the *metu*”.

i-ta-ma za-ku šúm-ma la-a it-ta-ma
i+na UGU-ŠU *e-ri-a ul-la-da*
i-ra-bi-a i-ba-qa-an-na

He will swear an oath, and be cleared; if he has not sworn, they will conceive, give birth, be plucked and grow at his liability.¹⁰

7 Note also the writing *i-na me-te* in No. 35: more easily to be taken as “per 100” than “per <1> dead”.

8 The year numbering used here and later follows the table of eponyms reconstructed in Röllig 2008: 4.

9 A figure acknowledged by Röllig (note to No. 56: 6) to be “durchaus im Rahmen des üblichen”.

10 Note the similar clauses in a contract from Assur, KAJ 88 (cited by Röllig 2008: 86).

Similar oath-taking is found for the donkey herds in No. 48 and in Nos. 37 and 43, and these add the information that the herdsman had not skinned the cadavers (and consequently had been unable to present the skins as evidence of the loss).¹¹ It is frustrating that the word *me/iltu* is unknown. Röllig translates, with hesitation, “Flut” (see p. 70), but the use of *šipar* (KIN) makes an association with a human affliction sometimes called in medical texts *šipir mišitti*, to which he refers, very tempting, and we may note that in §266 of Hammurapi’s laws shepherds were not liable for losses from “the touch of the god” (*lipit ilim*), provided they swore an oath to substantiate this.¹² Whatever the nature of the *me/iltu*, it probably prevented the herdsmen from preserving the skins as evidence.

Birth-rates

After listing the skins and other diminutions from which the herdsman could be exonerated, a calculation was made of the annual yield, referred to as *tālitu*, “birth(-rate)”. There was, we must presume, a notional target which the herdsman was expected to meet. The basis for calculating this is nowhere made explicit, but it must have been well-known to both parties: in the case of state flocks in Old Babylonian Larsa the flock-master was liable to produce 80 new lambs for each 100 adult females, and whatever precise rate might be agreed in other places or times, it would seem most reasonable to tie the herdsman’s liability for the growth of the herd to the number of adult females, rather than to the overall number of animals or some other figure. Unfortunately the Middle Assyrian formulation is much more laconic than the Larsa chancery’s, and modern editors have not always agreed the meaning of the bald statement in No. 40 (see above): 40.TA.ÀM *ta-li-tu-šu*. With Jakob, I can only imagine that it means “his birth(-rate) is at 40”, and, given what we have found with the skins, the easiest interpretation of this would seem to be that it is in effect another percentage: “40 (per 100)”.¹³ If we accept for the time being that this is correct, we can then attempt to apply this to the two different rates mentioned in texts like No. 39, cited above. There we read “his birth(-rate) is at 60, for a birth(-rate) at 80 (per 100), 2 calves are lacking”.¹⁴ This would seem to mean that if he had had two more calves, he would have achieved a birth-rate of 80 (percent). If we reformulate this, it implies that the addition of 2 calves would bring his birth-rate up from 60%

11 No. 19: 19-20: *ma-a i+na mi-il-te mi-tu la a-ku-š[u]*, “they died from the *m.*, I did not skin (them)”; the same verb, in rather strange forms, in Nos. 43: 3’ and 48: 10, 23.

12 One might surmise that the Assyrian form was **mišdu*, a *pirs* formation in place of the Babylonian *mišittu*. For the OB texts cf. Postgate & Payne 1975: 6.

13 See Jakob 2003: 363f. His insight, based on a partial knowledge of the texts before publication, seems to be fully vindicated by the final edition.

14 Freydank 2010: 93 understands this passage the opposite way round, with 60 rather than 80 as the “Soll” or target, but it would be unusual for *maṭi’u* to mean “sind abgezogen” rather than “are lacking”.

to 80%, in other words his actual herd must have had 10 adult females with 6 new calves (making a 60% increase), but 8 new calves would have given a rate of 80%, which was perhaps the agreed ideal target. A total of 10 cows is on the low side, because in fact Adad-šuma-ereš had 18 adult females in the following year (No. 7; year 20) and 24 three years later (No. 8; year 23), but it is certainly not an inconceivable result.

One reason for thinking that we are looking at the discrepancy between “actual” and “target” (Röllig: “Zuchtsoll”) figures is the variation in the rates. Röllig’s table on p. 17a lists *tālittu* rates of 20, 30, 40, 50, 60, 70², and 80 for cattle, of 30, 40, 50, 60 and 70 for donkeys, and of 33, 50, and 55 for the flocks (sheep and goats are treated together). On the other hand, to judge from the few texts we have, the target rates appear to have been 60 for donkeys (No. 52, twice) and 80 both for cattle (Nos. 39; 48 and 55) and for flocks (Nos. 48 and 55). If a percentage is the correct interpretation, let us see how this would work with the two flock counts for which we have the figures. No. 48 (year 26) states: “his birth(-rate) is at 50, for (a birth-rate) at 80 he has underprovided (*umtaṭṭi*) 178 lambs” (ll. 27–28). Applying the same assumptions, this implies that 178 is the equivalent of 30%, so that the notional 100%, which would be the number of adult females, is 593, and the figure for the actual number of lambs, at 50% should be 296, whereas had he achieved the target 80% birth-rate the number of lambs would have come to 474. The preceding lines of No. 48 indicate that he owes a shortfall of 276 animals: “After 100 of his male sheep had been lifted (*mathūni*) for the palace, [1]37 ewes, 70 male sheep, 30 female goats, 28 male goats: Total 276 flocks as the capital he underprovided”. If the missing 137 ewes here are deducted from the target of 593 the actual number of ewes present in year 26 was 456. This agrees well with No. 23, a flock list from the following year 27 in which Adad-le’i’s flock numbered 1162 including 430 ewes, so that we have to assume that between the two annual stock-takes the head-count of ewes has fallen by 26, no doubt because the number of female lambs becoming adults was 26 less than the number of ewes lost during the year. These figures seem entirely plausible.

Turning to the cattle, the figures for No. 36 have been discussed by Röllig on p. 17 without any definite conclusion. To follow the pattern set by the flock counts, we need to assume that the figures for “birth” are represented by the 1-year old animals in the list, i.e. 16 females and 21 males. At 80% (80.TA.ÀM *ta-li-it-tu*) this total of 37 would require 42 adult females in the preceding year’s stock-take. Unlike the scribe, that figure we do not have, nor do we know how many 3-year-old heifers there were, which would also now be included in the total of 53 adult females (GUD.ÀB GAL), but here too the difference is not implausibly wide.

Conclusions

This is but one insight from the wealth of fascinating data from the Dur-katlimmu texts, and while it sheds light on pastoral conditions there, it also gives us an insight into the habits of the Assyrian accountants. It is evident that the yield statements we

do have are bureaucratic compilations from information which must previously have been recorded separately: the stock-take (*māšartu*) of the three different classes of animal (cattle, donkeys and flocks) inevitably involved different palace employees and can hardly have taken place at a single time and place. They are neither sealed nor witnessed, and must therefore have been unilateral records for the internal use of the administration, summarizing the annual position. There has to be a strong possibility that the raw data was originally recorded on primary documents which, although still internal to the administration, were bilateral and would have provided evidence of the liabilities and performance of each individual herdsman. Such texts must have supplied the raw figures on which these accountants' abstractions were based. Despite the understandable hesitations of colleagues,¹⁵ it seems certain that when calculating the expected and actual growth in flock numbers, as with the shepherd's liability to provide skins, the scribes used a figure per 100. This echoes the Old Babylonian target of 80 lambs per 100 ewes, but the Middle Assyrian scribes seem to have taken the practice further. No doubt their adoption of percentages was for the same reason that we use them for, to avoid cumbersome fractions and to express different proportions on an easily perceived scale of integers. Whether the practice was ever extended outside the world of animal husbandry remains to be explored!

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15 Röllig 2008: 16f. cites Jakob's discussion, but concludes that "die Vermutung, dass es sich bei den Verhältniszahlen jeweils um einen Prozentsatz handelt, kann nicht zutreffen". Freydank, who has also tussled with these texts, retains the opinion that the figures must be "Stückzahlen", and writes "Eine solcherart verallgemeinerte Praxis und damit auch mathemathikhistorisch beachtenswerte Errungenschaft scheint jedoch im vorliegenden Kontext von vorherein höchst fragwürdig und darf bei allem Respekt vor den Fähigkeiten der Assyrer nicht erwartet werden" (2010: 87).