The Antilopine Wallaroo: an unusual 'roo

Sarah Hirst
Email: sarah44778@octa4.net.au
PO Box 24 Darwin River NT 0841

Abstract
The antilopine wallaroo (*Macropus antilopinus*) is sometimes regarded as a kangaroo both colloquially by local bushies who call them 'red kangaroos' and by some members of the scientific community who find their habits are more similar to the true kangaroos then the wallaroo group. Antilopines are the largest macropods found in the savannah woodlands of northern Australia. They are sexually dimorphic from the time they develop fur, with the males reddish in colour with paler undersides whilst females usually have white under parts with grey head and shoulders and brownish back and hindquarters. Adult males are also 3-4 times larger than females.

I developed a fascination for this unique species when I hand reared my first antilopine joey in 1999 for the Territory Wildlife Park where I have worked since 1998. I have more or less specialised in rearing antilopine wallaroos since then with about 40 antilopines passing through my care. My husband and I have rehabilitated and released many of those animals from our 20 acre property at Blackmore River about 70km south of Darwin.

A number of antilopines continue to visit regularly providing an invaluable rehabilitation tool for new joeys and also offering otherwise unattainable opportunities for behavioural observations on this poorly understood species, including a number of previously undocumented observations on their breeding biology. During this presentation I will show some amazing pictures of mating and birth in the antilopine wallaroo. I will also present preliminary data on growth rates and comparisons between hand reared and parent reared joeys.

In my experience antilopine wallaroo joeys are incredibly clumsy (with a few that could even be described as dumb!) and therefore vulnerable to self-injury and a number of other problems. One of the more serious problems I found with handrearing this species is chronic sucking which can lead to long term developmental retardation. I will share some of my attempts to prevent this and other problems encountered with antilopine wallaroos.

Introduction

Description and maturity

Antilopine wallaroos (*Macropus antilopinus*) are sometimes referred to as kangaroos by scientists due to their shape, (Calaby, 1998) behaviour and habitat use (Dawson, 1995). Many Top End locals also refer to them as 'red kangaroos' due to the size and colour of the males. Adult male antilopine wallaroos are usually reddish tan in colour with black tipped paws and hind feet and almost white undersides. (Fig 1) Male antilopine wallaroos have a distinct swelling of the nose above the nostrils that is presumed to assist with cooling when panting. They become sexually mature from 2 years of age at about 25kg (pers. obs. n = 2) with the largest males reaching 50-60kg (Ritchie, 2004) 60+ kg (Croft, 1982) and possibly up to 70kg (Dawson, 1995).

Antilopine wallaroos are sexually dimorphic, with distinct differences in both size and colouration between the sexes. Adult females only reach between 15 and 30kg and usually have grey head and shoulders and brownish tan on the back and hindquarters. They have black tips to the paws and hind feet with white underparts similar to the males,

but females have white tips on the back of their ears. (Fig 2) Female antilopines become sexually mature from about 16 months of age (475 days, n = 1) when the pouch starts to develop and the teats evert (Dawson, 1995) (Fig 3). Development of the pouch indicating the onset sexual maturity appears highly variable with some individuals not showing signs of pouch development until around 20 months. Oestrus (indicated by male interest) and mating does not occur until their second wet season, at about 2 years of age (n = 6).

The colour difference appears in joeys soon after the fur emerges at 6-7 months, allowing easy sex determination of pouch joeys in the field (Fig 4). An experienced eye can also sex pouch joeys with reasonable accuracy from the first observed emergence of the head, (181 ± 13 days, n = 6) by the shape of the head and particularly the breadth of the nose, with females being more petite. Other sexually dimorphic macropods such as the black wallaroo do not develop colour dimorphism until the males reach maturity – why it is so early in antilopine wallaroos is an opportunity for future research.

Distribution and habitat

The antilopine wallaroo is the largest macropod found across monsoonal tropical Australia, occurring throughout the savannah woodlands from the Kimberley to the Gulf of Carpentaria and also on Cape York Peninsula (Dawson, 1995) (Fig 5). Croft (1982) studied a population in the Finnis River area in June 1979 where he describes the area inhabited as open woodland across several low ridges and grassy depressions. Calaby (1998) states that antilopine wallaroos are more common in open woodland where perennial grasses dominate the understorey. Personal observations support this statement indicating that antilopine wallaroos in the Top End of the Northern Territory have a distinct preference for low laterite gravel ridges and the associated perennial grass *Heteropogon triticeus.* The home range of individual groups appears to be centred on these laterite ridges although they also use adjacent habitats, particularly in the Dry season after fires when the low country between ridges produces fresh green shoots.

Behaviour

Antilopines also exhibit an unusual behaviour known as sexual segregation during the Dry season, once all sexually mature females have pouch young. Large males form small single sexes groups while the females, young at foot and young males remain together in larger groups. Ritchie (2005-2006) suggests this may be due to dietary preferences based on different nutritional requirements for large males and the smaller antilopines, although the influence of variable predation risk and activity patterns on behaviour is not yet fully understood.

Why antilopine wallaroos?

Antilopine wallaroos became special to me in 1999, when I handraised my first antilopine joey for the Territory Wildlife Park (TWP). I started work in mid 1998 at TWP in the then Animal Care Centre that included the 'Kangaroos and Friends' exhibit. This was a dream come true for me as I have always been interested in wildlife since my childhood on a bush property west of Pine Creek. At TWP I was working closely with many fascinating native animals, observing their behaviour, and best of all, I could share my passion for wildlife with visitors to the park.

As joeys, antilopine wallaroos are much bigger and more dependent than agile wallaby joeys. They are incredibly clumsy and get themselves in all sorts of trouble, but they can only be described as affectionate. Joeys will rub themselves against their carer in a cat-like manner. This behaviour appears to be due in part to the strong bonds developed during the extended period of maternal/carer dependence and also their social tendencies. When observing antilopine wallaroos at rest it is easy to see that physical contact is important to this species with mothers and young, and even adult males grooming each other; behaviour known as allogrooming. (Croft, 1982). (Fig 6a,b)

Another area of particular interest to me is the rehabilitation and release of wildlife. As our rural block at Blackmore River is included the home range of a group of wild antilopine wallaroos, I took advantage of this opportunity to combine my interests. Since 1999 I have had about 40 antilopine joeys in my care with many of these undergoing self-release from our 20 acre property. A number of the released antilopines continue to return to the safety of our property on a regular basis, providing an invaluable rehabilitation opportunity for new joeys, and offering rare glimpses of natural behaviour that would not otherwise be observed.

Breeding biology observations

My observations have led me to conclude that antilopine wallaroos do not have diapause or post partum oestrus. Females do not give birth until after mating, usually during the Wet season and oestrus/mating does not occur again until the resultant joey is emergent.

Oestrus

Approaching oestrus was indicated by the arrival of large wild males with a particular female for 3-4 consecutive days. Oestrus was pinpointed when the female began to accept the attention of young males from the rehab group, and tolerated attempts to mate (Fig 7). In subsequent seasons oestrus appears unrelated to the age of the previous joey, however oestrus always occurred after the permanent emergence of the joey (n = 6), or after loss of the semi emergent joey to predation (n = 2). The first females in the group to come into oestrus each season tend to be synchronised to within a few days of each other (n = 4), therefore onset of oestrus may be related to feed availability and/or nutritional status of the female. Females that do not become pregnant after mating, were mated again after days 37-47 days, indicating a variable oestrus cycle of 42 ± 4.8 days (n = 4). Dawson (1995) documents an equally variable oestrus cycle of 41.0 ± 4.2 days when there was no birth. Females continue to cycle until mid year if mating is unsuccessful with most females having pouch young by April and all sexually mature females having pouch young by mid July (n = 14). It is not known if females would continue to cycle throughout the year if no pouch young attaches or if a male is unavailable. Adult males only leave the main group (to form a bachelor group) after the last female has an attached pouch young.

Mating

Occurrence of mating was established either by observation or the presence of a sperm plug, where mating was then presumed to have occurred during the preceding night. I was privileged on Christmas Day 2005 to observe at close range mating between a wild male and a released female. The male was so completely focussed on following his natural urges that he chose to ignore me and my camera tripod a matter of meters away!

(Fig 8) It appears the female enters a trance-like state during mating where she was a completely passive participant and was at times almost lifted off the ground by the male. Neither male nor female reacted to the many marsh flies biting their legs and tail.

It seems that the successful male is not necessarily the biggest (most dominant?) male in the area. I observed several females 'choose' a younger/smaller male to mate with, even when a much larger male is waiting nearby. I am also puzzled why two females mating on consecutive days have different partners. The first female attracted the attention of biggest male in the vicinity (Fig 1), but he was conspicuously absent the following day when a smaller male mated with the second female (Fig 8).

Gestation

From my observations gestation in the antilopine wallaroo is 35 days ± 0.9 days (n = 7) which is similar to Dawson (1995) who reported gestation as 33.9 ± 1.3 days. I noted one female had consecutive gestations of 35 and 36 days, which explains the longer average gestation figure. A particularly interesting observation was the interest by males in females for 3-4 days prior to birth. However all male interest ceased abruptly when the neonate reached the pouch successfully. There is another research opportunity here to determine why the males take such an interest in females about to give birth if there is no postpartum oestrus and the earliest mating does not occur until about a week later if there is no joey?

Birth

The birthing process is similar to that documented for other macropod species. The female spends a significant amount of time cleaning her pouch and abdomen in the hours preceding the birth. She then adopts a classic macropod birthing posture of sitting with her tail between her legs whilst she continues to lick at her pouch and cloaca. Of the two births observed, one female used a vertical object (the front wall of the house!) for support. There appears to be a significant amount of discomfort involved as the female becomes restless and alternately stands and sits on her tail. She attempts to stand whilst lifting her tail upward, and her waters break with a rush, producing approximately 1 teaspoon of fluid. She then concentrates cleaning up this fluid. The cloaca starts to evert periodically suggesting contractions and she stands again, expelling the wriggling neonate from her cloaca (Fig 9).

The neonate dangles from the umbilical cord and struggles to reach the fur. The mother overbalances and falls down only to manoeuvre back into a sitting position. She licks at the neonate, dislodging it from outside of the cloaca so that it dangles from the umbilical cord before beginning to climb once again. After a few minutes the neonate reaches the fur and appears to pull itself free of the restriction of the cord and begins to climb in earnest using a swimming motion. The mother continues to lick at the neonate sporadically, appearing to hinder its progress. From emergence from the cloaca to disappearance over the rim of the pouch takes about 8-10 minutes (n = 2) depending on the amount of hindrance (licking) by the mother. The mother ignores the neonate once it enters the pouch but continues cleaning herself for some time after the birth. She finally settles down to rest about 20 minutes later.

Pouch life

Once attached to the teat inside the pouch the joey is more or less ignored by both the mother and any young at foot still suckling, apart from brief cleaning episodes by the mother often performed late in the day before moving off to graze. The ears are visible on the joey at 20 days (n = 1) and at 20 weeks (140 days, n = 1) the joey's eyes begin to open and soon afterwards it begins to peer out at the world (183 ± 15 days, n = 6). Females appear to be puzzled by this suddenly animate creature protruding from her pouch and have been observed sniffing and peering at the joey almost as though wondering 'where on earth did that come from?'

Emergence

At about 6 months (207 ± 18 days, n = 4) the joey begins to tumble out of the pouch for the first time; barely furred, very wobbly and uncoordinated, then quickly dives back into the pouch. From this point onward the joey grows rapidly with regular exercise usually taken during the day when the mother is resting. By around 37 weeks (261 ± 23 days, n = 5) after spending significant amounts of time outside, the joey is no longer allowed back into the pouch. The mother simply allows her pouch muscles to relax completely and there is nothing for the joey to dive into (Fig 10).

Weaning

Young antilopines are not weaned by their mothers for several months after permanently exiting the pouch and have been observed still drinking at almost 15 months of age (446 days, n = 4). Joeys gradually feed less often, and weaning does not appear to be a significant step with no aggression necessary to achieve it, unlike for other species such as the agile wallabies. Even after weaning young antilopine wallaroos continue to have a close relationship with their mother; resting together and grooming each other. Some young females move off (n = 2), presumably to start new groups, with the timing of departure coinciding with emergence of the mother's next joey.

Growth rates and rearing comparisons

It is difficult to obtain measurement data for parent reared joeys prior to emergence without causing significant stress to both mother and joey. For this reason data has only been collected opportunistically after emergence (Fig 11). Although female joeys seem to have finer features than male joeys, there does not appear to be any apparent differences in growth rates or development.

Comparison of parent reared joey growth curves with that of handreared joeys shows an obvious flat or 'slow start' in handreared joeys (Fig 12). Whether this is due to the trauma and stress of the orphaning event, artificial diet or other factors cannot be determined at this stage. Handreared joeys also appear to have significantly lower body weights at around the 200 day stage, but this could be an artefact due to age estimations. Age estimations were based on development stage, such as eyes open, fur appearance and fur length. The analysis of data did not take into account variable body condition and hydration status of orphaned joeys, although this information was noted at the time of weighing.

Measurement data (Pes, tail and head length) has been collected, but this information has not yet been analysed. Preliminary indications suggest that head and pes length will be useful, but tail length is difficult to measure accurately or consistently on lively joeys.

Some development stages of parent reared antilopine wallaroos are shown in Fig 13. This chart should be used with caution as some milestones are represented by only a single record. My observations are ongoing and I hope to be able to improve on these charts in the future.

Accidents, injuries and other problems

In the years I have spent working with antilopine wallaroos I have found them to be an incredibly accident prone species. Some of the more unbelievable happenings include joeys that routinely chase cars, some for several kilometres; and two separate incidents of joeys that jumped into the coals of an open campfire and singed their feet.

Fractures

Fractures are relatively common with these injury prone joeys, especially fractures of the pelvis, tail or limbs. Pelvic fractures are often either from the orphaning event or from a fall onto a hard surface. In young joeys such fractures usually heal well with pouch rest and result in no permanent disability. Tail fractures are also usually the result of the orphaning event, although occasionally are the result of bone weakness due to a lack of calcium in the diet. They heal well with support to limit movement and although some limitation of normal movement is often evident on removal of the support, this resolves well with activity. Simple fractures of the straight bones of the limbs can be set successfully (with veterinary assistance) and also heal well with limited activity. If fractures involve the main joints, especially the hock, knee or hip, consideration should be given to the long term prognosis and the facilities required for maintenance of an unreleasable animal for the term of its life. My personal belief is that if an animal will be unfit for release, has no obvious educational or conservation value (ie placement at a wildlife park or breeding facility), or cannot be provided with permanent appropriate housing as a companion animal to assist with the rehabilitation of other orphaned or injured wildlife, then it should be immediately and humanely euthanased.

Macropods are also prone to neck fractures due to the fragility of the neck in their design, especially when exposed to fences; although I know of one antilopine joey that ran into a tree and fell down dead. Any disability resulting from impact with solid objects that lasts more than a few days should be x-rayed. For example a 2 year old male antilopine hit our newly erected joey yard fence resulting in significant loss of directional control and balance coupled with rapid wasting of the shoulder muscles. X-rays showed compression fractures of several vertebrae in his neck and veterinary advice was that he could suffer complete paralysis from the neck down at any time. It would have been inhumane to allow him to suffer this fate and he was euthanased.

Cuts and other injuries

Injuries from barbed wire fences are very common. I live in the rural area where this type of fencing is frequently used, so I spend time with all new arrivals teaching them to recognise and cross these fences safely. A number of minor injuries are inevitable with the most common being torn skin on the legs and ears. As injuries invariably occur when veterinary attention is difficult to reach, I have found the best way to heal tears and cuts scar free is to leave them uncovered and apply ‘Medihoney’ or Manuka Honey twice

daily to the wound. These honeys have antibacterial properties and are of course completely harmless if eaten. The skin closes up almost before your eyes and with a recent case involving two separate tears in the skin of about 30cm each, both wounds were completely healed in two weeks. Larger wounds may be stitched if the animal can be taken to a veterinarian. All wounds should be monitored closely for signs of infection and antibiotics may be required. If the wound is deep, a tetanus injection is recommended.

Abscesses on the feet have been seen on several occasions in antilopine wallaroos. Unexplained lameness and swelling, usually near the hock, leads to the eruption of an abscess on the side of the foot above the plantar surface after about a week, however once the abscess erupts it heals rapidly without treatment. The cause of these is unknown but may be from bruising or possibly the infection of a small puncture wound. Other injuries include lesions on the nose and various allergies involving swelling of the face and neck presumably from insect bites. (Fig 14a,b)

Tetanus

A serious risk to all macropods in the Top End is tetanus infection. Tetanus is caused by the soil borne bacteria *Clostridium tetani* which is an anaerobic bacterium that thrives in deep puncture wounds. I had an agile wallaby joey that was bitten by a small olive python, breaking a tooth off in the middle of the joey's back. The joey developed tetanus within 2 days. Small puncture wounds introducing tetanus may occur in the mouth or on the feet and not ever be detected by a carer. The old name for tetanus was "lock jaw" and if you ever have the misfortune to see an infected animal it is easy to see why. Usually the first indication is the joey become very quiet. This is followed by excessive saliva production and licking. Once the facial muscles begin to freeze up the joey simply drools. The body becomes unresponsive and then quite rigid, the back straightens, then arches and I have been told the spine may even fracture due to the powerful muscle spasms. Watching a joey suffer even the early stages of tetanus is a horrible experience. Although is it possible to treat tetanus in humans the progression of the illness is extremely painful and is usually treated by inducing patients to a coma. Most animals will die as a result of tetanus infection and it is inhumane to allow such suffering to continue. Once tetanus is suspected the animal should be euthanased as soon as possible.

On the positive side, the risk of tetanus infection in handreared joeys can be minimised (unfortunately not guaranteed) by two tetanus toxoid injections given 4 weeks apart and preferably completed before the joey starts going outside. There is a small risk of allergic reaction or an anaphylactic reaction to the tetanus injection so ideally the injections should be administered by either a veterinarian or other qualified person with adrenaline available in case of a severe reaction.

Parasites

Macropods do not usually have external parasites such as ticks or fleas. Occasionally a joey that has been housed with domestic pets will acquire fleas but these disappear rapidly if treated with a commercial flea powder. Antilopine wallaroos do suffer from lice infestations but these are not usually prevalent unless the animal is under significant stress. They too can be removed with an application of flea powder. During the Wet season antilopine wallaroos may develop small reddened lumps on the skin of the inside

of the legs, and these are caused by burrowing mites. They do not seem to cause irritation, but may be controlled by treatment of the animal with Ivomec Pour On (Ivermectin 5mg/ml) applied at 0.04ml/kg.

Antilopine wallaroos are vulnerable to internal parasites, such as nematodes (*Strongyloides*). Most macropods have some parasites present, but while agile wallabies are rarely affected by even heavy burdens, wallaroos may show poor growth, become lethargic or develop diarrhoea. If macropods are housed in or use the same area constantly, parasite build up is inevitable and usually becomes worse during the wet season. When feeding macropods in captivity or in a single location it is wise not to feed them on the ground as this increases the likelihood of (re)ingesting internal parasites from a contaminated environment. I use a length of PVC pipe split in half as a feed trough, as it allows access for many animals at once, is free of sharp edges and is easily cleaned (Fig 18). I also control nematodes using a routine treatment of all animals with Ivomec Pour On (Ivermectin 5mg/ml) at the rate of 0.04ml/kg on a monthly basis in the wet season and 3 monthly during the dry season. If it is not possible to apply a pour on treatment to the animals, oral treatment (such as Nilverm - seek veterinary advice for concentration and dose rates) may be given via food.

Coccidia infections are also a problem in macropods and in antilopine wallaroos cause severe diarrhoea and lethargy. Bacterial infections cause similar symptoms and are most often seen in joeys from inexperienced carers, usually as a result of poor hygiene and inappropriate diet. An experienced carer will usually recognise these infections by smell and if detected early, these types of infections can be managed by encouraging healthy gut flora using a probiotic powder such as Protexin in the milk. If there is no improvement after 24-72 hours or a rapid decline in attitude within this time, then urgent veterinary advice and treatment is necessary.

Fungal infections

Candida infections may occur in the digestive tract, and may be detected by sweet smelling, often bubbly yellow diarrhoea, and irritation of the cloaca. Candida infections may also occur in the mouth and form whitish plaques that in severe cases may block the airway. This will require treatment with oral antifungal drops such as Nilstat (seek veterinary advice for concentration and dose rates).

External fungal infections such as ringworm are relatively common in wild antilopine wallaroos. Ringworm infections are highly contagious (and also zoonotic) and although only a few members of the group may have lesions, all members should be treated if possible using a topical antifungal wash such as Malaseb (20g/L chlorhexidine gluconate 20g/L miconazole nitrate).

Sucking

A significant problem with antilopine wallaroos is chronic sucking. Sucking of the syndactyl toes is most common, but various body parts may be targeted. One joey sucked a patch of fur on her chest below her armpit and others suck the tip of their tail or the ears of other animals. Whilst this may seem cute when first encountered and other macropod species do grow out of sucking habits; antilopines do not. Initially sucking may be provoked by hunger, (it is a common problem in neglected joeys although this

seems easier to stop with the introduction of an adequate feeding regime) or as 'security blanket'. Emergent parent reared joeys have been observed with their head in the pouch without actually drinking (swallowing), presumably seeking comfort. Once started, the sucking easily becomes a deeply ingrained habit. Habitual sucking in older animals often seems to be triggered by an association with artificial feeding, where as soon as food is offered the sucking starts. Whilst sucking the animals enter a trance like state where they are unresponsive to noise or activity that cause the rest of the rehab group to scatter.

I cannot stress strongly enough how difficult it is to break this habit or how important it is to try. The sight of an adult female sucking on the ear of her pouch joey is truly sad! Another case is that of a three year old male that still sucks his toe. (Fig 15a) He is now only about half the size of his counterparts, and is also smaller than males a year younger. This individual also regularly suffers bloat and colic-like symptoms from the intake of air to his gut during sucking. A third chronic sucker that has developed a callous on his syndactyl toe causing it to project at an abnormal angle from his foot. (Fig 15b)

With these older offenders I tried applying sticking plaster for several weeks at a time, but as soon as it was removed the sucking started again. I even trialled products intended to prevent nail chewing, but this was ignored completely. The only success story I have so far was with a joey that sucked his toes but had only been orphaned for a few weeks. By wrapping sticking plaster around the toes (and then the tip of his tail when he started to suck that) for about two weeks I managed to break the habit. (Fig 16) The joey then sucked on his bedding but this is less of a problem as the bedding is removed eventually and then sucking stops. Presumably sucking does not occur when the animals are not around humans and/or food, otherwise predators would easily pick off the suckers. The solution for older animals may be to relocate the suckers to a wild group where no further human contact is likely, and I hope to trial this in the future.

<u>Other problems</u>

Several sex related problems observed in antilopine wallaroos include an inverted penis in young males, and a partially everted pouch in a female on reaching sexual maturity. In male joeys the penis is usually visible when urinating and when erect, but with an inverted penis the tip of the penis is retained inside the cloaca. This causes extension of the cloaca, but the problem resolves as the penis begins to develop when the joey gets older. The partially everted pouch was presumably due to poor muscle control of the pouch sphincter. The degree of eversion was unlikely to prevent her carrying a joey and this female was relocated and released before she bred so it is not known if the problem resolved once she had a joey present.

Summary

Antilopine wallaroos are unique in many ways. They are the only large macropod found in tropical northern Australia; they are highly social and exhibit sexual segregation behaviour. They are show colour dimorphism from a very early age (soon after fur appears), they have no diapause or post partum oestrus (unlike all other macropods in northern Australia), and therefore breeding is seasonal.

I have been fortunate to be able to observe these special animals through my work and also from my home where a number of released animals choose to return. Very little data

had been collected previously for this species and little was known about breeding biology, growth and development rates. My observations offer a small window into life of the antilopine wallaroo, and given time and ongoing opportunity I hope to continue to widen the knowledge base.

Acknowledgements
I would like to thank all those who have assisted me in a variety of ways; by giving me so many joeys to rear, donating joey rearing equipment, feeding or babysitting joeys and recording data; and most importantly to Mignon and Wildcare for the opportunity to share this information.

References
Calaby, J. H., 1998. *in* The Mammals of Australia. ed Strahan, R. Reed New Holland. Sydney. pp 324-325.

Croft, D. B., 1982. Some observations on the behaviour of the Antilopine Wallaroo *Macropus antilopinus* (Marsupialia: Macropodidae). *Aust. Mammal*. **5**: 5-13

Dawson, T. J., 995. Kangaroos, biology of the largest marsupials. Cornell University Press. New York. pp 25-26, 45, 71, 77-78.

Ritchie, E., 2004. Unique kangaroo a tropical treasure. *Savanna Links* **29**: 8-9

Ritchie, E., 2005-2006. Antilopine Wallaroo uncovered. *Nature Australia* Vol **28** No. 7 pp 24-31.