FINAL REPORT

PROJECT DAQ68

The Distribution of Vectors of Arboviruses
of Livestock in Northern Australia

Research Organisation — Queensland Department of Primary Industries
Oonoonba Veterinary Laboratory
PO Box 1085
Townsville Q 4810

Commencement — October 1989

Completion — October 1992

Principal Investigator — Dr Stephen Johnson

Phone Number — 077 222688

Fax Number — 077 784307

ABSTRACT

The project aimed to detect exotic *Culicoides* species recently established in northern Australia and to map the distribution of *Culicoides brevitarsis* and *C. wadai* in Western Australia and NT. Between February 1990 and June 1992, collections were made throughout Cape York Peninsula, Northern Territory and northern and central Western Australia. Six previously unreported species were collected. These species are considered unlikely to be recent immigrants and seem to pose little threat as potential arbovirus vectors. *C. wadai* was restricted to coastal northern Qld, the northernmost areas of NT and the northern Kimberley region in WA. In NT *C. brevitarsis* was collected as far south as Katherine. In WA it was collected throughout the Kimberley and in the Pilbara region in an area bounded by Nullagine, Karratha and 300km north of Carnarvon. *C. brevitarsis* remains the only *Culicoides* species of known importance as a vector of livestock arboviruses to extend into major sheep-grazing areas. Generally, *Culicoides* distributions in northern Australia between 1990 and 1992 were comparable but not identical to those defined in surveys conducted in the 1970's and 1980's. Species' distributions were not static and will continue to fluctuate with variation in rainfall.

FINAL REPORT FOR DAQ68 - PART 2

BACKGROUND AND INDUSTRY CONTEXT

Arboviruses such as bluetongue viruses, akabane and ephemeral fever cause or threaten various production losses and export trade impediments to cattle and sheep-based industries. The distribution of these viruses is determined largely by the distribution of the insect species which transmit them. Biting midges of the genus *Culicoides* include species implicated to various degrees of certainty as vectors of these arboviruses. *Culicodes* species because of their small size are considered highly suited to wind-asssited dispersal over long distances and this is thought to have introduced vectors such as *C. brevitarsis* and *C. wadai* into northern Australia from SE Asia. Further introductions are a constant possibility. *C. wadai* is thought to have been introduced as recently as the early 1970's. Many species in SE Asia are not yet present in Australia including known vectors such as *C. imicola* and closely related species such as *C. nudipalpis* and *C. orientalis*. The vector status of most SE Asian species is unknown but the intense arbovirus activity prevalent in SE Asia suggests a number of species may be acting as vectors.

The distribution and abundance of vector species in Australia is not static but changes due to climatic variation and as a result of long term expansion in some recently introduced species such as *C. wadai*. When last surveyed in the mid 1980's, *C. wadai* was expanding its distribution. Consequently areas currently considered vector free are threatened by the possibilities of long-term permanent expansions of new or recently introduced species and also short-term temporary invasions of existing vectors during and following periods of favourable climatic conditions.

OBJECTIVES

The project aimed to detect the presence of exotic *Culicoides* species which may have recently established in northern Australia, to map the distribution of *Culicoides brevitarsis* and *C. wadai* in Western Australia and to investigate the potential distribution limits of these 2 vectors of bluetongue virus.

METHODOLOGY

Between February 1990 and June 1992, 546 insect collections were made by miniature light traps, vehicle-mounted nets, (truck traps), and sampling of potential larval habitats. The area surveyed included Cape York Peninsula, Northern Territory (NT) and northern and central Western Australia (WA), (figure1).

Collection records were combined with records for northern Qld from a concurrent survey of vector distributions in eastern Australia, (WRDC project CT13) to enable the distribution of *C. brevitarsis* and *C. wadai* in northern Australia to be analysed. Two predictive models, "Bioclim" and "Climex" were used to assess the likely climatic limits of each species.

RESULTS AND CONCLUSIONS

Species not previously reported

Six species which have not previously been reported from Australia were collected, (figure1). *Culicoides minimus* (Drysdale River Station, April 1990 and Mitchell Plateau, May 1991) is a member of the subgenus *Avaritia* which includes a number of vectors. Consequently it must be regarded as a potential vector. It is extremely similar to *C. actoni* a bluetongue vector considered native to Australia. It was described in 1989 and consequently if collected prior to this it would have been identified as *C. actoni.* This was confirmed by a retrospective search of the Australian National Insect Collection (ANIC) by Alan Dyce which revealed 3 specimens collected in 1979 near Darwin and Proserpine which fitted the description for *C. minimus.* As a result it cannot be regarded as a recent introduction.

C. species near *dumdumi* (Batavia Downs Research Station, February 1991) is also a member of the subgenus *Avaritia* and so must also be regarded as a potential vector. A similar search of ANIC revealed 2 specimens tentatively identified under a different name and collected at Mudginberri Station, NT in 1978 and Cardwell in 1980. Consequently this species cannot be regarded as a recent introduction.

C. species near *pseudocordiger* (Cape Arnhem, June 1990) is a member of the *molestus* species group which is most developed in Australasia but also found in Asia and Africa. The group contains no known vectors. The only known breeding site for these species is estuarine sands and so they pose little or no threat to inland areas. It may be a recent introduction but it is more likely that it merely hasn't been collected before because few collections have been made in the Cape Arnhem area.

C. (Wirthomyia) species undetermined (Bathurst Island, April 1991) also came from a previously poorly-collected location in NT and so it is impossible to determine whether it is a recent introduction. The subgenus does not contain any known vectors.

C. dryadeus (Prince of Wales Island, August 1990) occurs throughout SE Asia and PNG and is a member of the *shermani* species group which contains no known vectors. Again, Alan Dyce was able to reveal an earlier Australian record, in this case from Cape York Peninsula.

C. yasumatsui (Prince of Wales Island, December 1991) occurs throughout SE Asia and PNG and is a member of the *williwilli* species group which contains no known vectors. Again, the lack of previous collections from this site makes it impossible to judge whether it is a recent introduction.

The imprecise identifications of some of these specimens was unavoidable because the taxonomy of Australasian *Culicoides* is very complex and its study is not yet complete.

With the exception of *C. minimus* which was collected twice, all these species were collected only once and in small numbers. Because of their rarity and limited distribution, all these species seem to pose minimal threat as potential vectors. No evidence of distribution expansion within Australia was found for any of these species.

Changes in the Distribution of Endemic Species

C. peregrinus is a stock-feeding species which, although it has been infected with bluetongue virus in laboratory trials, is not considered an effective vector. It was regularly collected at Kununurra whereas in previous surveys it had not been collected beyond the northernmost areas of NT. Its potential for further spread seems limited as it tends to be associated with tropical floodplains.

C. actoni is a potential bluetongue vector. It was not collected west of Mitchell Plateau whereas in 1979 it was collected at Derby.

C. fulvus is a competent bluetongue vector. Its collection at Drysdale River Station is the first record of this species in WA. Its potential for further spread seems minimal as it is restricted, presumably because of its unknown larval habitat, to high rainfall tropical coastal and subcoastal areas.

C. oxystoma was not collected outside NT. In 1979, it was collected at Kununurra and Kalumburu Mission in the Kimberley. Akabane virus has been isolated from this species.

Distribution of *C. wadai* and *C. brevitarsis*

The distribution of *C. wadai* and *C. brevitarsis* throughout the survey are summarised in figure 1. The distribution of *C. wadai* in northern Australia is comparable to that defined by previous surveys with 2 exceptions. In 1979 it was collected as far west in WA as Derby but in this survey had contracted eastward. In Qld it has not previously been collected as far west as Mt Surprise but its absence from there in the later years of the survey suggests that this was a temporary rather than a permanent extension. The distribution of *C. brevitarsis* was slightly less extensive than in surveys conducted in the late 1970's and early 80's when it was collected aproximately 200km further south in WA and as far south as Alice Springs in NT. No evidence of long term distribution expansion within Australia was found for either species but a definitive assessment of this would require a longer survey period to allow for the short term fluctuations in distribution caused by climatic variability.

C. wadai was consistently abundant only at Innisfail. At other locations it was collected sporadically and generally in low numbers suggesting that in most areas where it occurred its populations remained at low levels. In Queensland it was most widespread in 1990 when the wet season was prolonged. By comparison the wet season of 1991 was intense but short and the distribution of *C. wadai* was less extensive. This suggests that the length of the wet season is more important than actual amount of rain in limiting the distribution of *C. wadai*. Its distribution was relatively stable in NT being limited to the northernmost, higher rainfall areas for the entire survey. In WA it was collected occasionally in low numbers in the northernmost areas of the Kimberley.

C. brevitarsis was most abundant in coastal and subcoastal Qld and the northernmost areas of NT. It was collected only intermittently in northwest and central Queensland and in the Pilbara, suggesting that population levels were lowest in these areas. Although fluctuations in distribution and abundance occurred during the survey they were less pronounced than those for *C. wadai*.

The predictive model "Climex" was applied to records for *C. brevitarsis* and *C. wadai* in order to estimate biological parameters relevant to their distribution and abundance. The parameters which best fitted the current distribution estimated that *C. brevitarsis* was limited by moisture and cold stress but that heat stress was not limiting. Consequently, in northern Australia where low temperatures are rarely limiting, the distribution and abundance will fluctuate with variation in rainfall and when above average rainfall allows, all cattle areas of northern Australia are potentially suitable for *C. brevitarsis*. This is supported by previous records. In 1976, *C. brevitarsis* was collected at Alice Springs. Extrapolation of these parameters to southern WA estimated that the coastal and subcoastal areas between approximately Perth and Geraldton were marginally suitable for *C. brevitarsis*. If exceptionally wet conditions allowed *C. brevitarsis* to cross the drier areas to the north, it is possible that it could expand into this area permanently.

The parameters which best fitted the current distribution of *C. wadai* estimated that it was limited by cold and moisture stress to a greater extent than *C. brevitarsis* and to a minor degree by heat stress. Consequently in northern Australia its distribution and abundance can also be expected to fluctuate with rainfall and it will probably remain restricted to higher rainfall areas.

Arbovirus activity throughout the survey period was monitored by MRC Project DAQ67. Seroconversions to bluetongue viruses occurred at 3 sites within the area of this survey, all in northern Qld. At 2 of these sites both *C. brevitarsis* and *C. wadai* were collected in the 2 months prior to seroconversion. At the other, only *C. brevitarsis* was collected and was abundant prior to seroconversion.

Impact on Industry

This survey has determined the current distribution of vectors in northern Australia and by comparison with earlier surveys has enabled some assessment of long and short term changes which have occurred. This in turn will enable improved estimates of likely distributions in the future.

The survey established the necessary infrastructure and has provided a valuable baseline for any future studies, particularly monitoring for the introduction of exotic species.

The survey has enabled expertise in *Culicoides* identification and biology to be developed in QDPI and WADA, increasing the number of skilled people available in the event of an outbreak of an arboviral disease.

This survey in conjunction with the arbovirus surveillance project (DAQ67) will be valuable in the determination of current regional and temporal freedom from arboviruses and their vectors. However it would need to be continued to fulfil this purpose in the future.

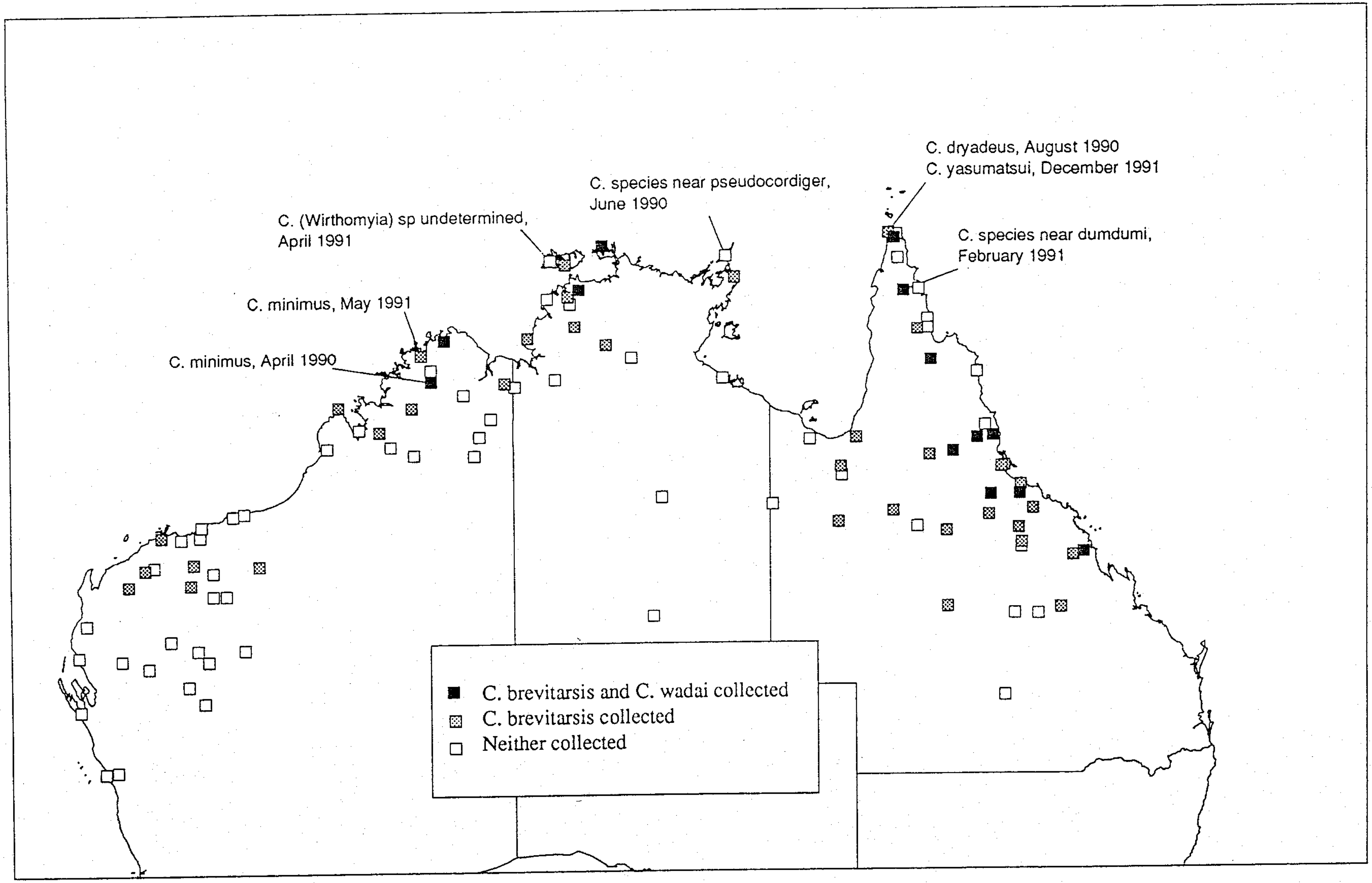


Figure 1: Species collected not previously reported in Australia and distribution of Culicoides brevitarsis and Culicoides wadai in collections made between February 1990 and July 1992

FINAL REPORT FOR DAQ68 - PART 3

BACKGROUND AND INDUSTRY CONTEXT

Arboviruses such as bluetongue viruses, akabane and ephemeral fever cause or threaten various production losses and export trade impediments to cattle and sheep-based industries. The distribution of these viruses is determined largely by the distribution of the insect species which transmit them. Biting midges of the genus *Culicoides* include species implicated to various degrees of certainty as vectors of these arboviruses. *Culicodes* species because of their small size are considered highly suited to wind-asssited dispersal over long distances and this is thought to have introduced vectors such as *C. brevitarsis* and *C. wadai* into northern Australia from SE Asia. Further introductions are a constant possibility. *C. wadai* is thought to have been introduced as recently as the early 1970's. Many species in SE Asia are not yet present in Australia including known vectors such as *C. imicola* and closely related species such as *C. nudipalpis* and *C. orientalis*. The vector status of most SE Asian species is unknown but the intense arbovirus activity prevalent in SE Asia suggests a number of species may be acting as vectors.

The distribution and abundance of vector species in Australia is not static but changes due to climatic variation and as a result of long term expansion in some recently introduced species such as *C. wadai*. When last surveyed in the mid 1980's, *C. wadai* was expanding its distribution. Consequently areas currently considered vector free are threatened by the possibilities of long-term permanent expansions of new or recently introduced species and also short-term temporary invasions of existing vectors during and following periods of favourable climatic conditions.

OBJECTIVES

The project aimed to detect the presence of exotic *Culicoides* species which may have recently established in northern Australia, to map the distribution of *Culicoides brevitarsis* and *C. wadai* in Western Australia and to investigate the potential distribution limits of these 2 vectors of bluetongue virus.

METHODOLOGY

Between February 1990 and June 1992, 546 insect collections were made by miniature light traps, vehicle-mounted nets, (truck traps), and sampling of potential larval habitats. The area surveyed included Cape York Peninsula, Northern Territory (NT) and northern and central Western Australia (WA), (figure1).

Culicoides and mosquitoes were retained from collections. *Culicoides* were identified to species and any uncertain identifications referred to Mr A. L. Dyce, the Australian authority on the genus.

Most collections were made by a network of voluntary cooperators which was established at the start of the project and maintained and modified throughout the project. Cooperators included graziers and staff of the WA Department of Agriculture the NT Department of Primary Industries and Fisheries and the Queensland Department of

Primary Industries, particularly Northern Australian Quarantine Surveillance staff. The remainder of the collections were made on a number of field trips conducted during periods of high insect activity.

Collection records were combined with records for northern Qld from a concurrent survey of vector distributions in eastern Australia, (WRDC project CT13) to enable the distribution of *C. brevitarsis* and *C. wadai* in northern Australia to be analysed. Two predictive models, "Bioclim" and "Climex" were used to assess the likely climatic limits of each species.

RESULTS

Species not previously reported

Six species which have not previously been reported from Australia were collected, (figure2).

Culicoides minimus (Drysdale River Station, April 1990 and Mitchell Plateau, May 1991) is a member of the subgenus *Avaritia* which includes vectors such as *C. brevitarsis, C. wadai, C. imicola* and *C. fulvus*. Consequently it must be regarded as a potential vector. It is extremely similar to *C. actoni* a bluetongue vector considered native to Australia. The species description was not published until 1989 and consequently if collected prior to this it would have been identified as *C. actoni*. This was confirmed by a retrospective search of the Australian National Insect Collection (ANIC) by Alan Dyce which revealed 3 specimens collected in 1979 near Darwin and Proserpine which fitted the description for *C. minimus*. As a result it cannot be regarded as a recent introduction.

C. species near *dumdumi* (Batavia Downs Research Station, February 1991) is also a member of the subgenus *Avaritia* and so must also be regarded as a potential vector. A similar search of ANIC revealed 2 specimens tentatively identified under a different name and collected at Mudginberri Station, NT in 1978 and Cardwell in 1980. Consequently this species cannot be regarded as a recent introduction.

C. species near *pseudocordiger* (Cape Arnhem, June 1990) is a member of the *molestus* species group which is most developed in Australasia but also found in Asia and Africa. The group contains no known vectors. The only known breeding site for these species is estuarine sands and so they pose little or no threat to inland areas. It may be a recent introduction but it is more likely that it merely hasn't been collected before because few collections have been made in the Cape Arnhem area.

C. (Wirthomyia) species undetermined (Bathurst Island, April 1991) also came from a previously poorly-collected location in NT and so it is impossible to determine whether it is a recent introduction. The subgenus does not contain any known vectors.

C. dryadeus (Prince of Wales Island, August 1990) occurs throughout SE Asia and PNG and is a member of the *shermani* species group which contains no known vectors. Again, Alan Dyce was able to reveal an earlier Australian record, in this case from Cape York Peninsula.

C. yasumatsui (Prince of Wales Island, December 1991) occurs throughout SE Asia and PNG and is a member of the *williwilli* species group which contains no known vectors. Again, the lack of previous collections from this site makes it impossible to judge whether the species is a recent introduction.

The imprecise identifications of some of these specimens was unavoidable because the taxonomy of Australasian *Culicoides* is very complex and its study is not yet complete.

With the exception of *C. minimus* which was collected twice, all these species were collected only once and in small numbers. Because of their rarity and limited distribution, all these species seem to pose minimal threat as potential vectors. No evidence of distribution expansion within Australia was found for any of these species.

Changes in the Distribution of Endemic Species

C. peregrinus is a stock-feeding species which, although it has been infected with bluetongue virus in laboratory trials, is not considered an effective vector. It was regularly collected at Kununurra whereas in previous surveys it had not been collected beyond the northernmost areas of NT. Its potential for further spread seems limited as it tends to be associated with tropical floodplains.

C. actoni is a potential bluetongue vector. It was not collected west of Mitchell Plateau whereas in 1979 it was collected at Derby.

C. fulvus is a competent bluetongue vector. Its collection at Drysdale River Station is the first record of this species in WA. Its potential for further spread seems minimal as it is restricted, presumably because of its unknown larval habitat, to high rainfall tropical coastal and subcoastal areas.

C. oxystoma was not collected outside NT. In 1979, it was collected at Kununurra and Kalumburu Mission in the Kimberley. Akabane virus has been isolated from this species.

Distribution of *C. wadai* and *C. brevitarsis*

The distribution and abundance of *C. wadai* and *C. brevitarsis* throughout the survey are summarised in figures 3 and 4 respectively. The distribution of *C. wadai* in northern Australia is comparable to that defined by previous surveys with 2 exceptions. In 1979 it was collected as far west in WA as Derby but in this survey had contracted eastward. In Qld it has not previously been collected as far west as Mt Surprise but its absence from there in the later years of the survey suggests that this was a temporary rather than a permanent extension. The distribution of *C. brevitarsis* was slightly less extensive than in surveys conducted in the late 1970's and early 80's when it was collected aproximately 200km further south in WA and as far south as Alice Springs in NT. No evidence of long term distribution expansion within Australia was found for either species but a definitive assessment of this would require a longer survey period to allow for the short term fluctuations in distribution caused by climatic variability.

C. wadai was consistently abundant only at Innisfail. At other locations it was collected sporadically and generally in low numbers suggesting that in most areas where it occurred its populations remained at low levels. In Queensland it was most widespread in 1990 when the wet season was prolonged. By comparison the wet season of 1991 was intense but short and the distribution of *C. wadai* was less extensive (figure 5). This suggests that the length of the wet season is more important than actual amount of rain in limiting the distribution of *C. wadai*. Its distribution was relatively stable in NT being limited to the northernmost, higher rainfall areas for the entire survey. In WA it was collected occasionally in low numbers in the northernmost areas of the Kimberley.

C. brevitarsis was most abundant in coastal and subcoastal Qld and the northernmost areas of NT. It was collected only intermittently in northwest and central Queensland and in the Pilbara, suggesting that population levels were lowest in these areas. Although fluctuations in distribution and abundance occurred during the survey, (figure 6), they were less pronounced than those for *C. wadai*.

The predictive model "Bioclim" was applied to the records for *C. wadai* and *C. brevitarsis* (figures 7 and 8 respectively) in an attempt to measure the likely suitability of areas which were not surveyed or were surveyed only lightly. " Bioclim" averages the climate from positive locations and compares this to other locations and grades them on their similarity. The analysis must be interpreted with caution because of the following problems. The model does not take abundance into account but weights all positive locations equally with the result that marginal locations are classed as equally suitable as favourable locations. Because the collection records were biased towards the limits of the species' distributions, the model provided a poor fit with the observed abundance. The model does not consider cattle distribution, beyond which neither species can spread due to their requirement for cattle dung as a larval habitat. The analysis for *C. wadai* is best viewed as an estimate of the species' likely limits in northern Australia under average to above average rainfall since some of the records used in the analyses were obtained under conditions of above average rainfall but the model conducts the analyses on the average climate for each location. The analysis for *C. brevitarsis* estimates the limits under generally average conditions since positive records were more widespread and consequently the analysis was less affected by the above average rainfall in Qld in 1990.

The predictive model "Climex" was applied to records for the same species in order to estimate biological parameters relevant to their distribution and abundance. The parameters which best fitted the current distribution estimated that *C. brevitarsis* was limited by moisture and cold stress but that heat stress was not limiting. Consequently, in northern Australia where low temperatures are rarely limiting, the distribution and abundance will fluctuate with variation in rainfall and when above average rainfall allows, all cattle areas of northern Australia are potentially suitable for *C. brevitarsis*. This is supported by previous records. In 1976, *C. brevitarsis* was collected at Alice Springs. Extrapolation of these parameters to southern WA estimated that the coastal and subcoastal areas between approximately Perth and Geraldton were marginally suitable for *C. brevitarsis*. If exceptionally wet conditions allowed *C. brevitarsis* to cross the drier areas to the north, it is possible that it could expand into this area permanently.

The parameters which best fitted the current distribution of *C. wadai* estimated that it was limited by cold and moisture stress to a greater extent than *C. brevitarsis* and to a minor degree by heat stress. Consequently in northern Australia its distribution and abundance can also be expected to fluctuate with rainfall and it will probably remain restricted to higher rainfall areas.

Acclimation to colder and/or drier conditions may affect the future distribution of *C. brevitarsis* and *C. wadai*. Acclimation has been shown for other species of insects such as fruit flies and it enables their distribution to spread into previously unsuitable areas. Although neither the comparison with previous surveys nor the "Climex" analysis suggest its presence for these species, any acclimation which does occur would be a slow process and only evident in the long term.

Because their relationship with rainfall is quite complex and indirect it was not possible to confidently quantify annual rainfall limits for each species.

Arbovirus activity throughout the survey period was monitored by MRC Project DAQ67. Seroconversions to bluetongue viruses occurred at 3 sites within the area of this survey, all in northern Qld. At 2 of these sites both *C. brevitarsis* and *C. wadai* were collected in the 2 months prior to seroconversion. At the other, only *C. brevitarsis* was collected and was abundant prior to seroconversion.

ACHIEVEMENT OF OBJECTIVES

The project successfully detected species not previously reported in Australia but the possibility that other newly-introduced species were present but not collected is an unavoidable problem which must be acknowledged. Introduction of exotic species is likely to be a slow and random process. Consequently surveys for exotic species need to be prolonged to be truly successful and as a result any limited survey cannot be regarded as conclusive.

The current distributions of *C. brevitarsis* and *C. wadai* in NT and WA were successfully determined. However it is possible that very low populations in marginal areas were not detected resulting in possible slight underestimation of distributions. The survey was too short to assess long term distribution changes. This assessment has instead relied on comparisons with previous surveys. Also the survey was too short to accurately determine the distribution limits of these species. This would require collections throughout a period which encompassed the full range of climatic variation experienced in northern Australia. Collections during and after consecutive years of widespread above average rainfall such as occurred in 1974-75 would be particularly useful in determining the maximum distributions of these species. Predictive analyses have been conducted to estimate distribution limits but these cannot be applied with the same confidence as collection records unless they are validated with records from collections made under those conditions.

Because of the short duration of this survey, the Queensland Department of Primary Industries will attempt to continue at least some of this survey from its own resources until an alternate source of funding can be arranged.

INTELLECTUAL PROPERTY

Not applicable

COMMERCIALISATION

Not applicable

IMPACT ON MEAT AND LIVESTOCK INDUSTRY

The distribution and abundance of *Culicoides* vectors largely determines the distribution of arboviruses of cattle and sheep some of which cause or threaten production losses and/or trade impediments. Distribution and abundance of species is not static and may change radically if new species are introduced. This survey has determined the current distribution of vectors in northern Australia and by comparison with earlier surveys has enabled some assessment of long and short term changes which have occurred. This in turn will enable improved estimates of likely distributions in the future.

The survey established the necessary infrastructure and has provided a valuable baseline for any future studies, particularly monitoring for the introduction of exotic species.

The survey has enabled expertise in *Culicoides* identification and biology to be developed in QDPI and WADA increasing the number of skilled people available in the event of an outbreak of an arboviral disease.

This survey in conjunction with the arbovirus surveillance project (DAQ67) will be valuable in the determination of current regional and temporal freedom from arboviruses and their vectors. However it would need to be continued to fulfil this purpose in the future.

TOTAL FUNDING

As per original application and contract.

CONCLUSIONS AND RECOMMENDATIONS

No exotic *Culicoides* species considered to pose a threat to livestock were detected.

Distributions of *Culicoides* species in northern Australia were generally comparable but not identical to those defined in surveys conducted in the 1970's and 1980's. *C. brevitarsis* remains the only *Culicoides* species of known importance as a vector of livestock arboviruses to extend into major sheep-grazing areas. With the exception of *C. peregrinus*, no evidence of long term distribution expansion was detected for any *Culicoides* species.

Species distributions are not static but will continue to fluctuate, due primarily to the variability of rainfall in northern Australia. There is considerable potential for some species, particularly *C. brevitarsis*, to expand their distribution temporarily into normally vector free areas during and following periods of above average rainfall.

Monitoring for species recently introduced from SE Asia and PNG should continue in Cape York Peninsula, northern Northern Territory and the Kimberley with increased focus on wet season collections.

Distributions of known vectors, especially *C. brevitarsis*, should be monitored by brief intensive annual surveys until data for consecutive years of optimal conditions have been collected to establish the limits of the distribution fluctuations which are observed from year to year. This should be supplemented by field and laboratory studies into their biology to enable their climatic limits to be better defined and possibilities of acclimation to cooler and or drier conditions to be addressed.

Central WA, particularly coastal areas, should be monitored, especially during and after exceptionally wet years, to give early warning of any southward spread of *C.brevitarsis* towards potentially suitable areas in southern WA.

Northern Queensland should be monitored for species introduced from Northern Territory especially *C. oxystoma.*

MEDIA COVERAGE

Media releases prepared and distributed by QDPI:
 10/1/1990 - Vector surveillance and sentinel herds
 25/5/1990 - "Bluetongue surveillance line set up in north"

Townsville Bulletin:
 May 1992 - "Lab our northern guard against disease"

Countryman (WA rural newspaper):
 26/3/1992 - "Scientists scour the north for evidence of bluetongue"

North Queensland Register:
 Date unknown - "Insect traps monitoring bluetongue"

Interview with local TV station, Karratha, WA
 April 1991 - Vector surveillance

Interview with Cairns correspondent for ABC Rural Radio
 June 1992 - Vector surveillance

PUBLICATIONS

W.M. Doherty, D.S. Gibson, S.J. Johnson, G.A. Bellis and A.L. Dyce
Culicoides survey of northern Australia, 1990-1992.
To be presented at the Sixth Australian Arbovirus Symposium, Brisbane, 7-11 December 1992

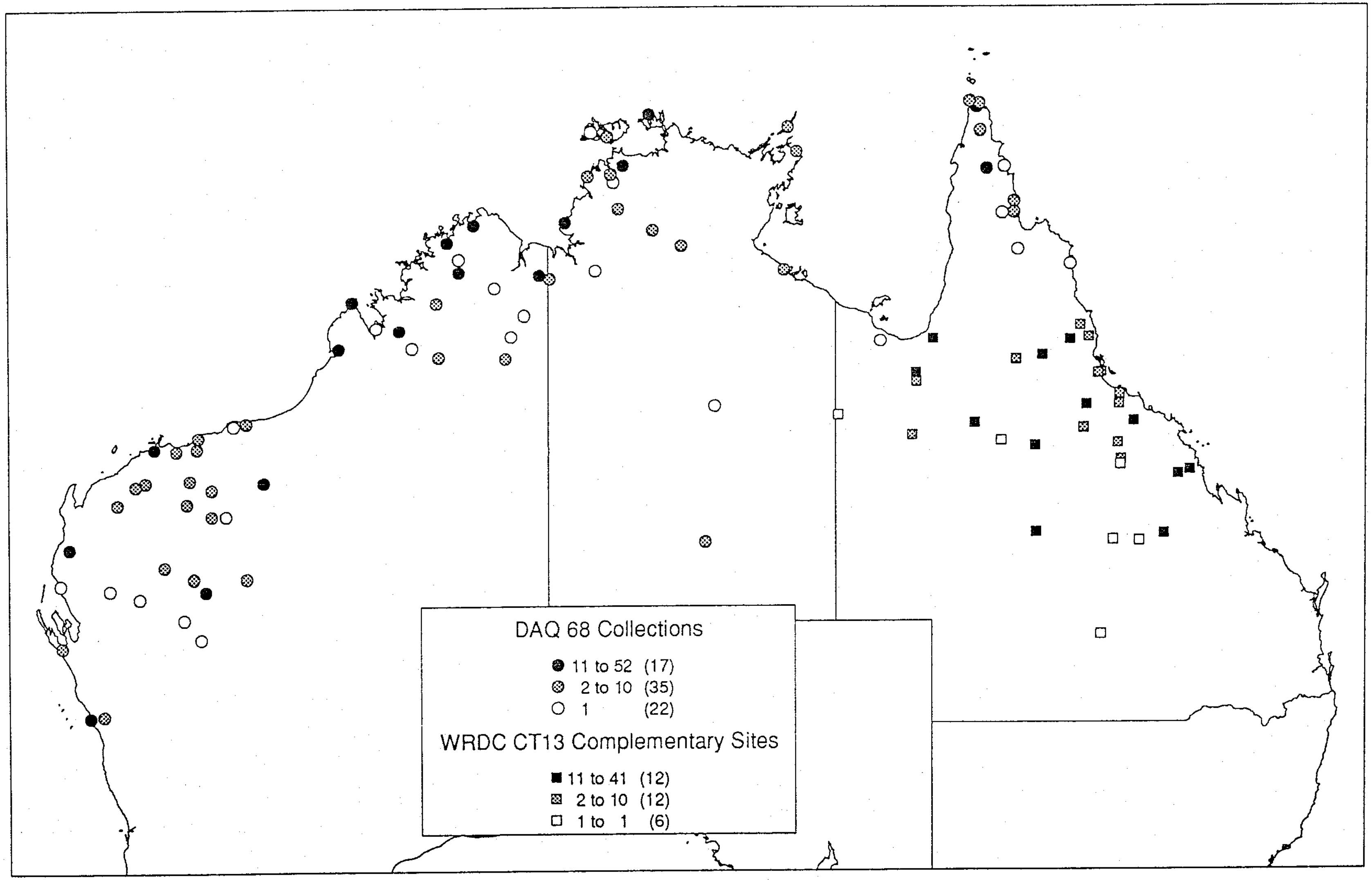


Figure 1: Number of collections at each site including complementary sites from WRDC CT13 used in analyses

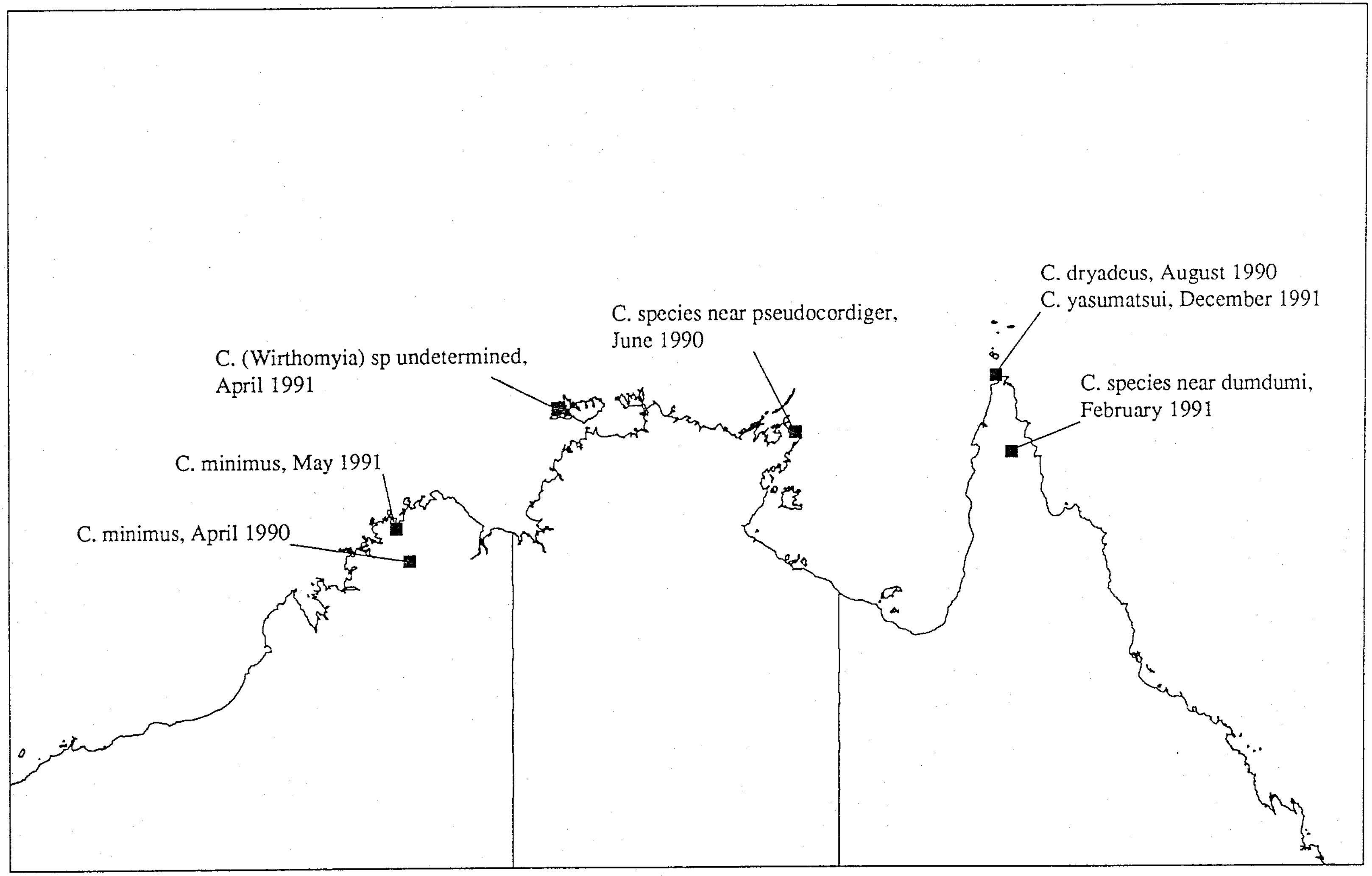


Figure 2 : Species collected not previously reported from Australia

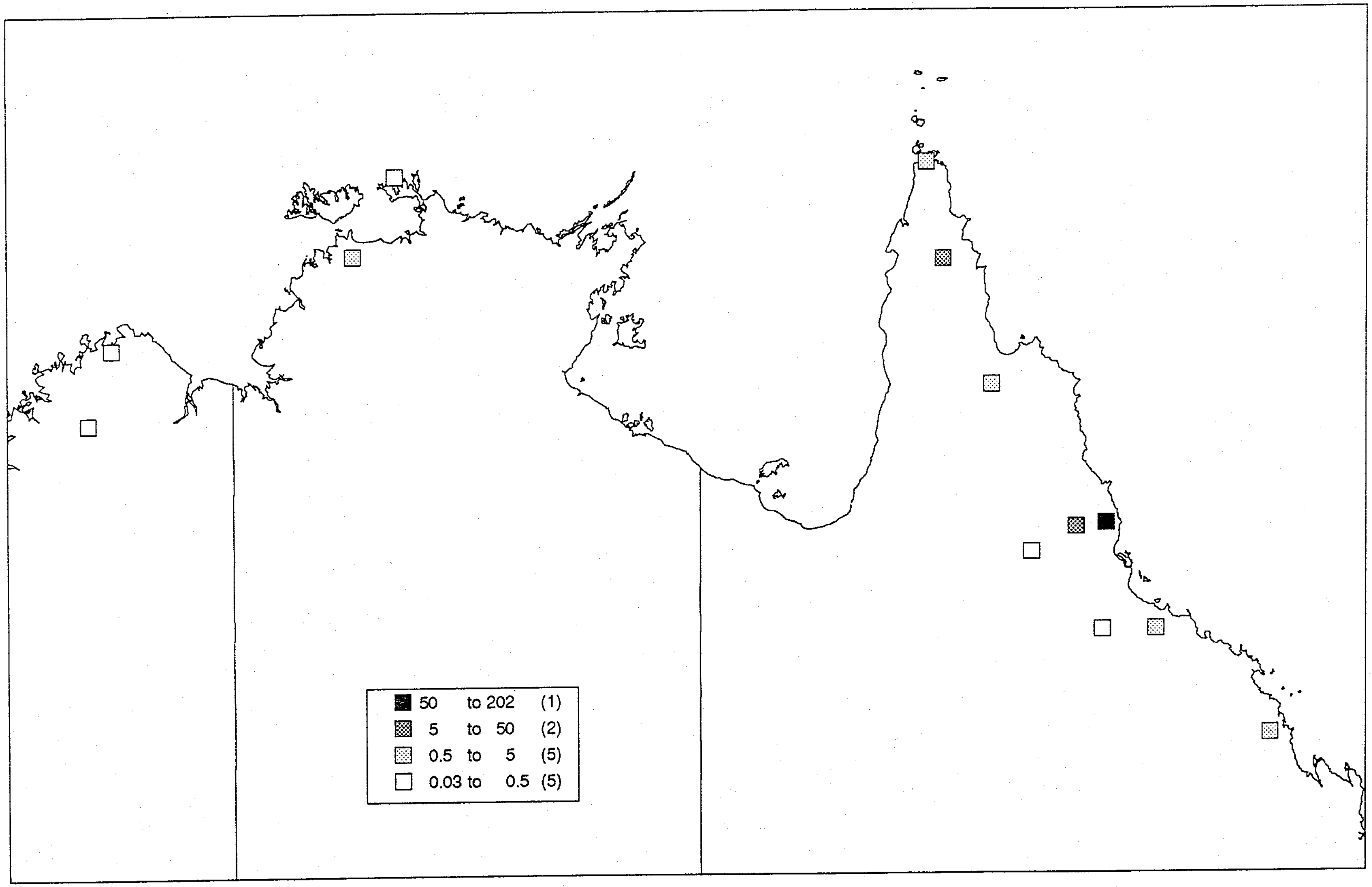


Figure 3: Mean numbers of C. wadai collected in light and truck traps for entire survey period

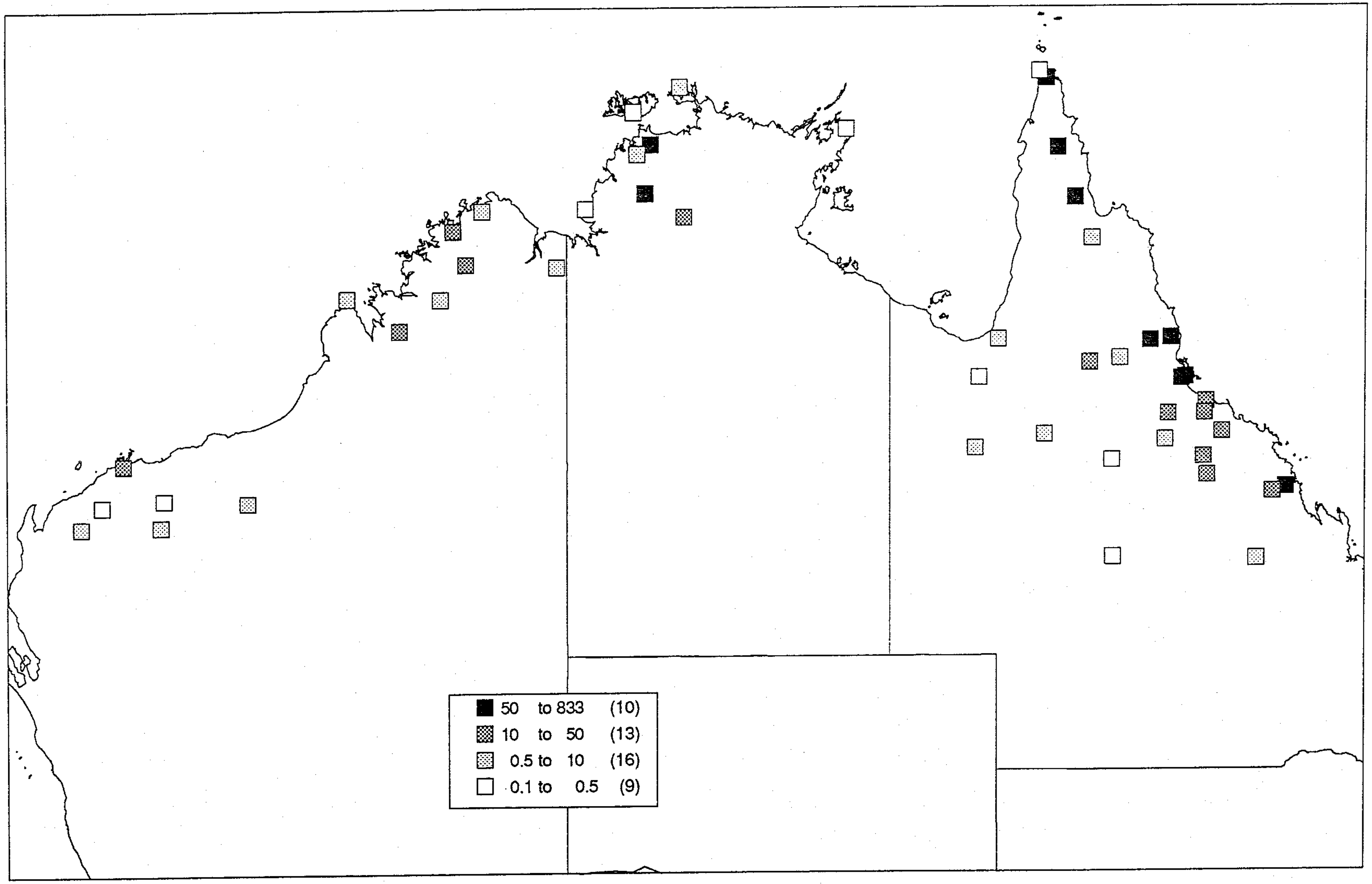


Figure 4: Mean numbers of C. brevitarsis in light and truck trap collections for entire survey period

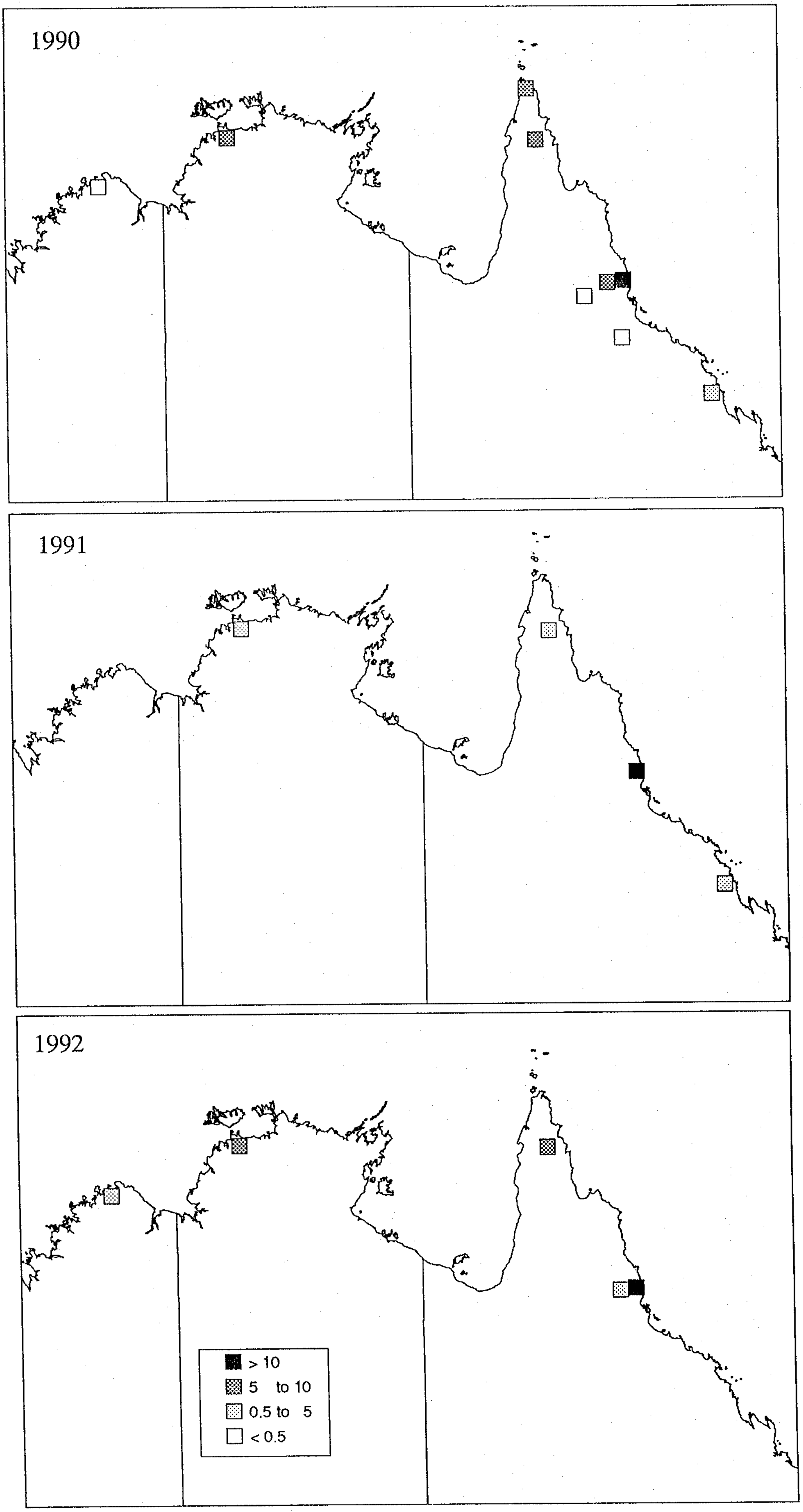


Figure 5: Mean collections of C. wadai for February to July of each year

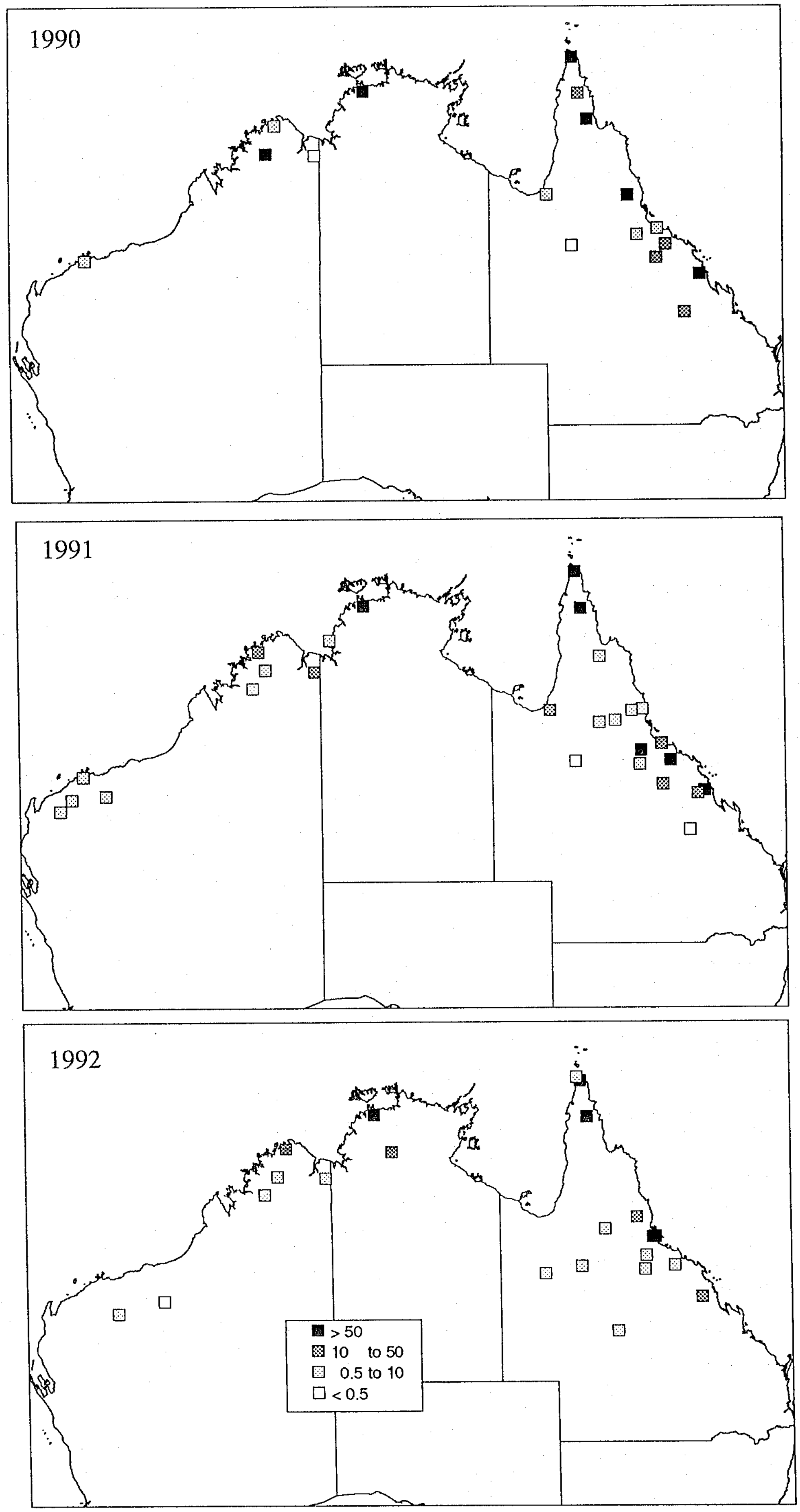


Figure 6: Mean collections of C. brevitarsis for February to July of each year

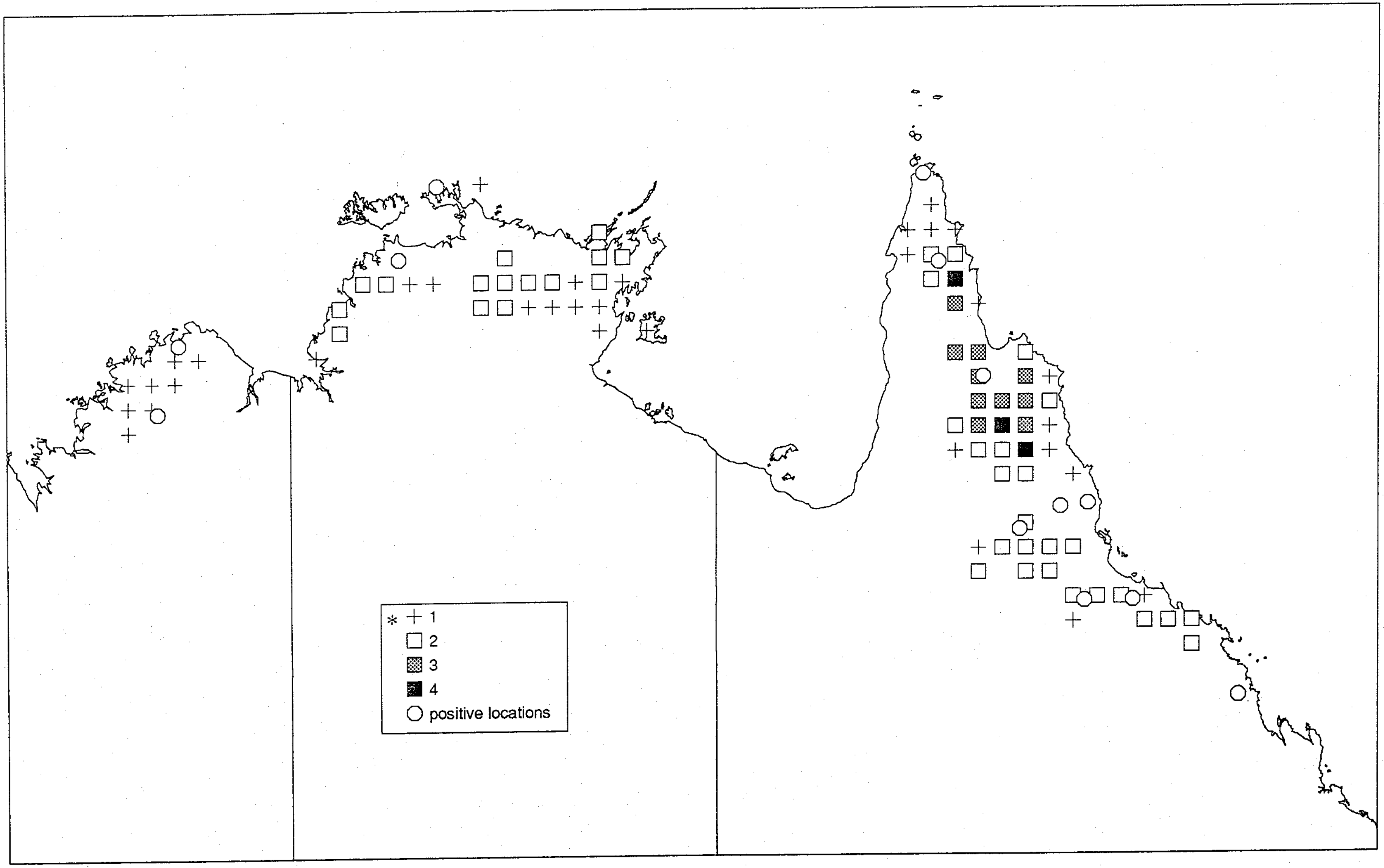


Figure 7: "Bioclim" analysis of the climatic suitability of northern Australia for C. wadai
* : Climatic suitability increases with increasing values and points labelled 2 or greater are generally best predictors of suitable areas

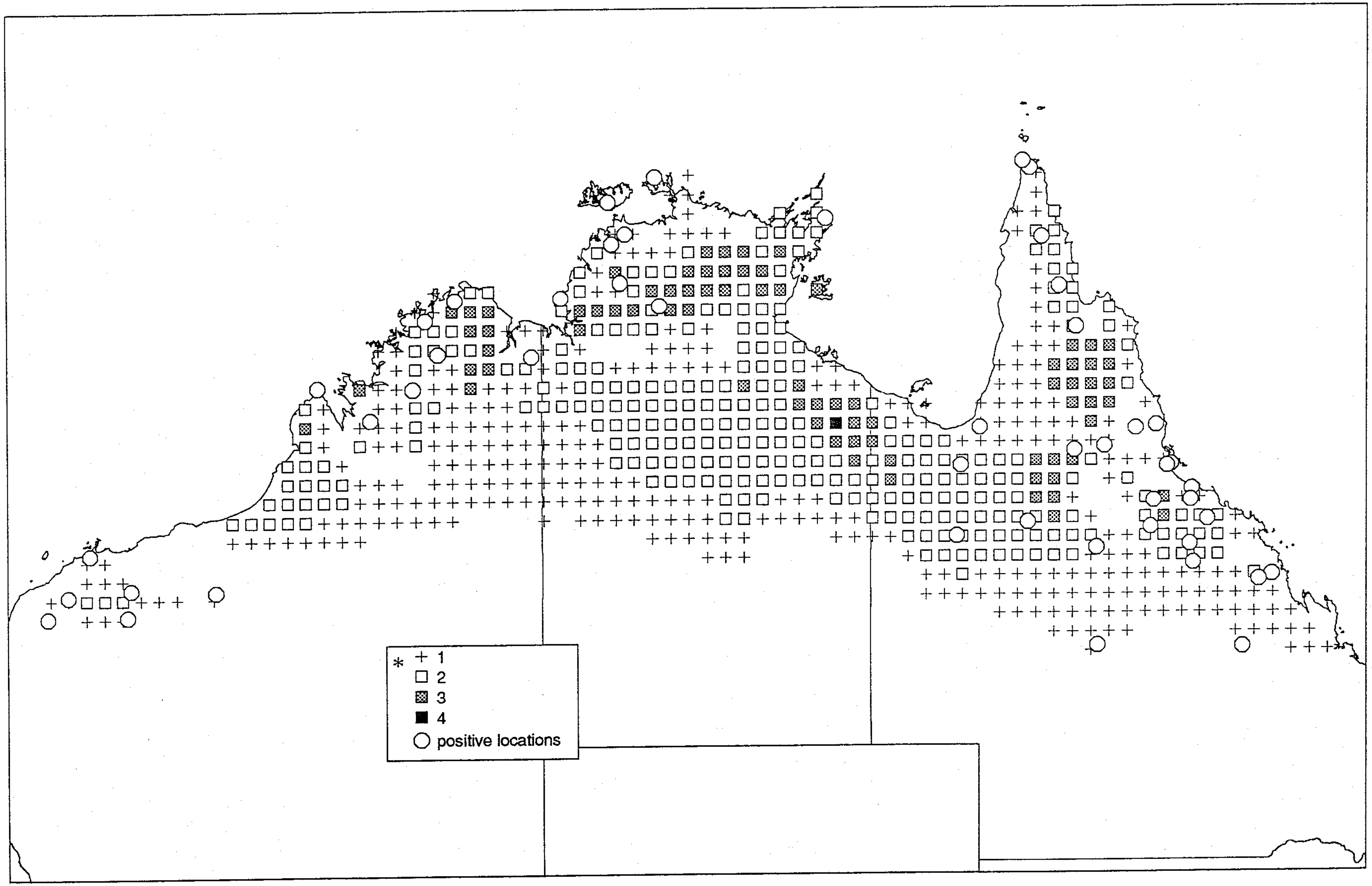


Figure 8: "Bioclim" analysis of the climatic suitability of northern Australia for C. brevitarsis
* : Climatic suitability increases with increasing values and points labelled 2 or greater are generally best predictors of suitable areas

North Queensland Primary Industries team plays a vital link inAustralia's bluetongue monitoring program.

Early warning centres have been established in NSW, Qld, WA and theNT to alert the sheep industry to the possible movement ofbluetongue disease within Australia.

Bluetongue is a virus disease of sheep and cattle which, along withfoot and mouth disease and rinderpest, is one of the three mostfeared exotic livestock diseases Australia faces.

Several strains of bluetongue are already present in Australia butso far these viruses have not caused any major livestock problems.

As a precaution, State and Commonwealth Governments have decidedto keep a close watch on the situation by setting up and monitoringa chain of sentinel herds across the country.

Each State is responsible for maintaining its own set of sentinelherds and there are twenty of these in Queensland.

Staff monitoring the sentinel cattle take blood samples from thestock at regular intervals in order to check for the presence ofbluetongue and related viruses.

These blood samples are then sent either to the QueenslandDepartment of Primary Industries' Oonoonba Veterinary Laboratoriesat Townsville, or the NSW Department of Agriculture's GlenfieldLaboratories in western Sydney.

Staff from the DPI's Oonoonba Labs monitor the blood samples fromthe twenty sentinel herds in Queensland, five herds in the NorthernTerritory and the five herds located in the north of WesternAustralia.

Bluetongue is spread by biting insects such as midges.

These biting pests are known as insect vectors.

In addition to carrying bluetongue, these vectors spread otherrelated virus diseases, known as arboviruses.

These viruses cause the diseases ephemeral fever and akabane.

Ephemeral fever causes three day sickness in cattle, while akabanecauses abortions and birth abnormalities in cattle.

Akabane is a serious disease in New South Wales and extends fromthe north of the state as far south as the Central Coast andHighlands.

Staff from the CSIRO Division of Tropical Animal Health'sLongpocket Laboratories, in Brisbane, and the DPI's Oonoonba labsare about to begin a series of surveys of Australia to determinewhat species of bluetongue vectors are present here.

From these surveys, the scientists hope to establish thedistribution of the insect vectors.

These survey trips are to be carried out once a year.

Staff from Oonoonba will cover all of Australia north of a linerunning through Rockhampton in Queensland and Geraldton in WA,while scientists from the CSIRO's Longpocket Labs will cover thesouthern half of the continent, down to Bega on the NSW south
coast.

The first vehicle survey from Oonoonba will start in mid Februaryand will be a two month marathon of over 5 000 kilometres, endingin Broome, about eight weeks later.

While on the trip, the team will be looking for suitable fieldsites to set up vector traps.

By monitoring these traps the scientists hope to establish thedistribution of the vectors.

Local landholders and government officers have already volunteeredto operate the traps and any insects caught will be preserved inalcohol and sent back to Oonoonba for positive identification.

The two vectors most worrying animal health authorities andproducers are two species of biting midges called Culicoides wadai-and Culicoides brevitarsis-.

Both of these vectors are common in eastern Australia and the northof Western Australia, where they are found from the base of theKimberleys and then across into the Northern Territory.

Timor, a close northern neighbour of Australia also has a speciesof Culicoides- that is very efficient at spreading bluetongue andits related viruses, known as arboviruses.

Because of the dangers of bluetongue to the sheep industry, it isessential that both animal health scientists and producers have anearly warning system in place to alert them to the possible entryof these Timorese species into Australia.

Identifying and locating bluetongue vectors may also have importantimplications for Australia's live sheep export trade.

Some countries are already insisting that sheep for export onlycome from areas that are free of bluetongue viruses or are free ofthe bluetongue vectors.

As the distribution of vectors can change from winter to summer,it is important for our live sheep trade that we are able toidentify those areas of Australia that are free of the bluetonguevectors in any given season.

The trapping surveys will help to determine these safe areas.

The Australian Wool Corporation has been a big supporter of thework, providing funds to conduct the surveys in Queensland, NSW and Victoria, while the Australian Meat and Livestock Research andDevelopment Corporation has provided funds to finance the surveywork across the Northern Territory and Western Australia.

ENDS....

Wednesday 10th January 1990.

Prepared by Queensland Department of Primary Industries Media andPublic Relations Unit, 12 Wickham Street, Townsville, Q. 4781.
Ph (077) 22-1440 Fax (077) 72-1958.

Further Information: Dr Steve Johnson. (077) 78-2688.

Journalist: Peter Bowey. (077) 22-1459.

Bluetongue Surveillance Line set up in North

North Queensland is playing a vital link in Australia's bluetongue monitoring program.

Early warning centres have been established in NSW, Qld, WA and the NT to alert the sheep industry to the possible movement of bluetongue within Australia.

Bluetongue is a virus infection of sheep and cattle which, along with foot and mouth disease and rinderpest, is one of the three most feared exotic livestock diseases Australia faces.

Several strains of bluetongue are already present in Australia but so far these viruses have not caused any major livestock problems.

As a precaution, State and Commonwealth Governments have decided to keep a close watch on the situation by setting up and monitoring a chain of sentinel cattle herds across the country.

Each State is responsible for maintaining its own set of sentinel herds and there are twenty of these in Queensland.

Staff monitoring the sentinel cattle take blood samples from the stock at regular intervals in order to check for the presence of bluetongue and related viruses.

These blood samples are then sent either to the Queensland Department of Primary Industries' Oonoonba Veterinary Laboratory at Townsville, or the NSW Department of Agriculture's Camden Laboratory in western Sydney.

Staff from the DPI's Oonoonba Lab monitor the blood samples from the twenty sentinel herds in Queensland, five herds in the Northern Territory and five herds located in the north of Western Australia.

Bluetongue is spread by biting insects such as midges.

These biting pests are known as insect vectors.

In addition to carrying bluetongue, these vectors spread other related virus diseases, known as arboviruses.

These viruses cause the diseases ephemeral fever and akabane in cattle.

Ephemeral fever causes three day sickness in cattle, while akabane results in abortions and birth abnormalities.

Akabane is a serious disease in New South Wales and extends from the north of the state as far south as the Central Coast and Highlands.

Staff from the CSIRO Division of Tropical Animal Health's Longpocket Laboratories, in Brisbane, and the DPI's Oonoonba labs have begun a series of surveys of Australia to determine what species of bluetongue vectors are present here.

From these surveys, the scientists hope to establish the distribution patterns of the insect vectors.

These survey trips are to be carried out once a year.

Staff from Oonoonba are in charge of monitoring all of Australia north of a line running through Rockhampton in Queensland to Geraldton in WA, while scientists from the CSIRO's Longpocket Labs cover the southern half of the continent, down to Bega on the NSW south coast.

The first vehicle survey from Oonoonba started in mid February and was a two month marathon of over 17 000 kilometres going as far as Geraldton in Western Australia.

While on the trip, the team looked for suitable field sites to set up vector traps.

By monitoring these traps the scientists hope to establish the distribution of the biting insect vectors.

Local landholders and Government officers volunteered to operate the traps and any insects caught will be preserved in alcohol and sent back to Oonoonba for positive identification.

The two vectors most worrying animal health authorities and producers alike, are two species of biting midges called *Culicoides wadai* and *Culicoides brevitarsis*.

Both of these vectors are common in eastern Australia and the north of Western Australia, where they are found from the base of the Kimberleys and then across into the Northern Territory.

Timor, a close northern neighbour of Australia also has a species of *Culicoides* that is very efficient at spreading bluetongue and its related viruses.

Because of the dangers of bluetongue to the sheep industry, it is essential Australia has an early warning system in place for the possible entry of these Timorese species of *Culicoides* into Australia.

Identifying and locating bluetongue vectors may also have important implications for Australia's live sheep export trade.

Some countries are already insisting that sheep for export only come from areas that are free of bluetongue viruses or are free ofthe bluetongue vectors.

As the distribution of vectors can change from winter to summer, it is important for our live sheep trade that we are able to identify those areas of Australia that are free of bluetongue vectors in any given season.

The trapping surveys will help to determine these safe areas.

The Australian Wool Corporation has been a big supporter of the work, providing funds to conduct the surveys in Queensland, NSW and Victoria, while the Australian Meat and Livestock Research and Development Corporation (AMLRDC) has provided funds to finance the survey work across the Northern Territory and Western Australia.

Bill Doherty an entomologist at Oonoonba and Dean Gibson, a senior technical officer with the CSIRO left on the survey in late February.

Drove to Normanton via Hughenden and Mackinlay, establishing *Culicoides* surveillance as they went.

There they put traps in at Cowan Downs station then drove to Katherine in the Northern Territory via Mount Isa and Tennant Creek.

The next stage of the journey was to Broome and Port Headland via Kununnurra.

They established traps at Karatha and Carnarvon then drove down to Geraldton where Dr Steve Johnson Officer In Charge of the Oonoonba Labs was waiting to join the team on the 8th of March.

Bill Doherty flew home from there while Dean and Steve Johnson established a trap at Geraldton then drove up through the Pilbara to Meekatharra where they set up a trap with the local Stock Inspector.

Over the next few days they established surveillance traps at Nullagi, 600 km north of Mt Newman, Roebuck Plains Station near Broome, and at the Lombardina Aboriginal Community on Cape Ladique, 200 km to the north of Broome.

Steve Johnson flew to Kununurra and chartered a plane to get into Drysdale River Station and Kalumburu mission, as there were no accessible roads.

While Steve was at Kalumburu, Dean went onto Derby and established a trap at Kimberley Downs Station.

Then he drove onto Hall's Creek and Kununurra establishing traps on the way.

Steve and Dean met again at Wyndham and drove to Darwin.

They had traps established through the Northern Territory government at Port Keats, Peppimenarti, the Coastal Plains Research Station near Darwin and on the Coburg Peninsula. They also had traps established at Pickertaramoor off the central Arnhemland Coast and at Gove.

Then they drove home to Townsville in two days.

They had covered 17,000 km in just five weeks.

As a result of their work Australia now has a network of surveillance traps that should pick up any early incursions of *Culicoides* midges into the north.

The traps are all the way along the coast from Geraldton to Townsville.

The lines of sentinel traps should also show what the vector distribution limits are and how close they come to sheep.

Steve Johnson says we need to know exactly where the *Culicoides* are and how far south they go in summer in W.A. and the eastern states.

The only gap in the trap line is now on Cape York Peninsula and surveillance traps will be sited at Bamaga and Batavia Downs next month. These should monitor any vector entries from the Cape York region.

Steve Johnson says we aren't going to pick up the first insect that drops in here.

"What's going to happen is that the insects will have to get established in the cattle population and multiply. We will then pick them up as they radiate out to reach the trap sites, as it is not feasible to put traps out all the way."

Steve Johnson also organised for the establishment of sentinel cattle herds in WA at Kununurra, Roebuck Plains and Hall's Creek. The Northern Territory has similar herds at the Douglas-Daly Research Station.

In Queensland there are twenty sites from Normanton east to Charters Towers, and Utchee Ck north to Batavia Downs.

There are also sentinel herds in NSW, Vic and SA.

There are none in Tasmania, as neither the vectors nor the viruses can survive there.

The surveillance traps are looked after by local people. These are either stock inspectors, managers, stockmen or the missionaries at Kalumburu.

Northern Australian Quarantine officers in these areas also look after traps and the offices in Broome and Darwin keep in touch with the local people to offer help if needed.

... Ends.

25th May. 1990.

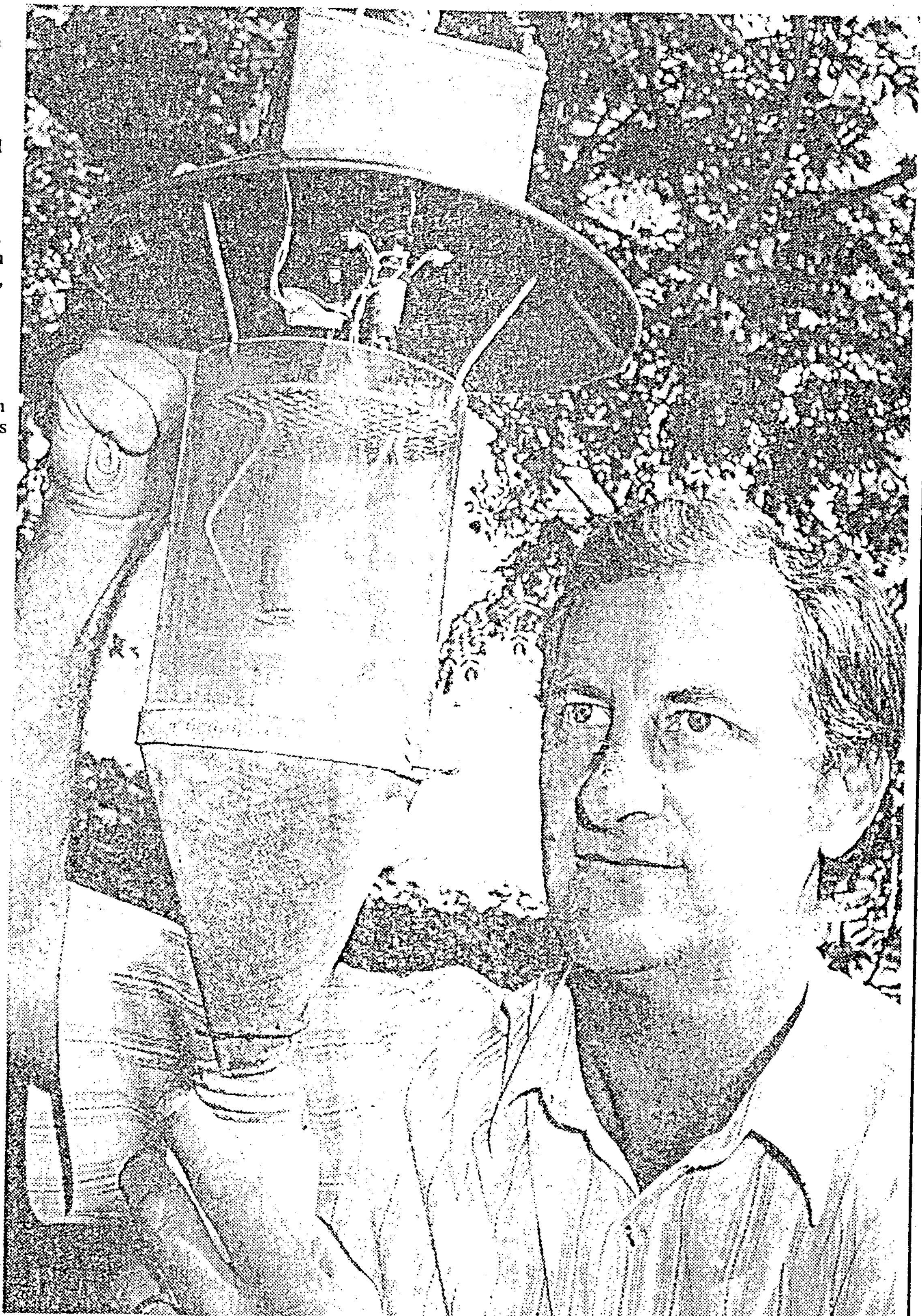
Prepared By the Queensland Department of Primary Industries Media and Public Relations Unit. PO Box 931 Townsville. Q. 4810. Ph (077) 22-1440 Fax (077) 72-1958.

Further Information: Steve Johnson (077) 78-2688.

Journalist: Peter Bowey. (077) 22-1455.

Lab our northern guard against disease

By ANNA CAHILL



Oonoonba Veterinary Laboratory manager Dr Steve Johnson with one of the insect traps he and his team have distributed throughout Northern Australia *Photo: MICHAEL CHAMBERS*

FEW people are aware of the vital role the Oonoonba Veterinary Laboratory plays as first line of defence against tropical animal diseases coming into Northern Australia.

The only fully equipped animal health diagnostic and research laboratory in the North, this Department of Primary Industries facility works quietly away at a wide range of routine analysis and special projects from an 80ha site on Townsville's doorstep just as it has for almost 80 years.

Blood testing, pathological examinations, insect identification, rapid disease diagnosis and development of animal vaccines are all part of its brief. It handles about 4000 diagnostic services a year, half of them for the beef industry.

All cattle for export must be tested negative for specific diseases and there's a daily consignment of blood samples from all the northern meat works.

The work embraces all farmed animals including fish and crocodiles as well as cats or dogs in quarantine.

The lab also helps with surveillance of migratory birds from as far away as Eastern Europe which may carry diseases including the viral Newcastle disease, the poultry equivalent of foot and mouth disease.

Apart from monitoring 27 sentinel herds of cattle across Queensland, the Northern Territory and Western Australia, the laboratory has also dotted the northern landscape with insect traps to map the distribution of endemic species and monitor what's coming into the country.

This is manager Dr Steve Johnson's particular area of interest. A veterinary entomologist, he says eight blue tongue viruses have been detected in this way — a disease which could wreak havoc in Australia's sheep industry and devastate the export trade if it found its way into flocks.

It's rare for a diagnostic laboratory to have open farm space and animal facilities to handle 40 to 100 animals at one time; most are set up in cities.

Consequently, the lab is attracting interest from overseas countries, particularly in vaccine development.

The lab is also firmly on the agenda for visitors from Third World countries as a result of its training programs and collaborative research.

Next month, four research projects worth about $500,000 come to an end but Dr Johnson is hopeful of picking up other allied work.

Scientists scour the north for evidence of bluetongue

THREE cattle herds and a series of light traps in the north of WA are keeping a check on a silent threat to our sheep industries — bluetongue disease.

An important part of the Northern Australian Quarantine Strategy (NAQS), is monitoring and mapping the spread of the biting midge which is the vector for the bluetongue virus, and detecting any possible entry of the virulent form of the virus.

Department of Agriculture co-ordinator and veterinarian for NAQS at Broome, John Curran, says bluetongue is a complex issue.

If the serious form of the virus reached the sheep-producing areas, it could cause major health problems and havoc for our export markets.

Flocks affected with bluetongue may have high death rates. Affected animals show signs of fever, swelling of the face, and swelling of the tongue, which causes the characteristic blue tongue. Pregnant ewes may abort.

Although it is primarily a sheep disease, bluetongue can also affect cattle, but in a much more mild form. Cattle are the best indicator of bluetongue disease because the biting midge prefers to feed off cattle.

"So even though there are no sheep flocks in the Kimberley, we can use cattle to detect any signs of the serious form of the virus," Mr Curran said.

"The sentinel cattle herds at Broome and Karratha are on two pastoral stations, Roebuck Plains and Karratha Station, which are co-operating in the project, while the Kununurra herd is at the Department of Agriculture's Frank Wise Institute of Tropical Agriculture.

"At Kununurra and Broome the cattle are indicators of new strains of bluetongue virus that could come in from Timor in Indonesia. The herd at Karratha is of special interest because the cattle there have contact with sheep. That gives us a better indication of how far the virus is moving south into the sheep-producing areas."

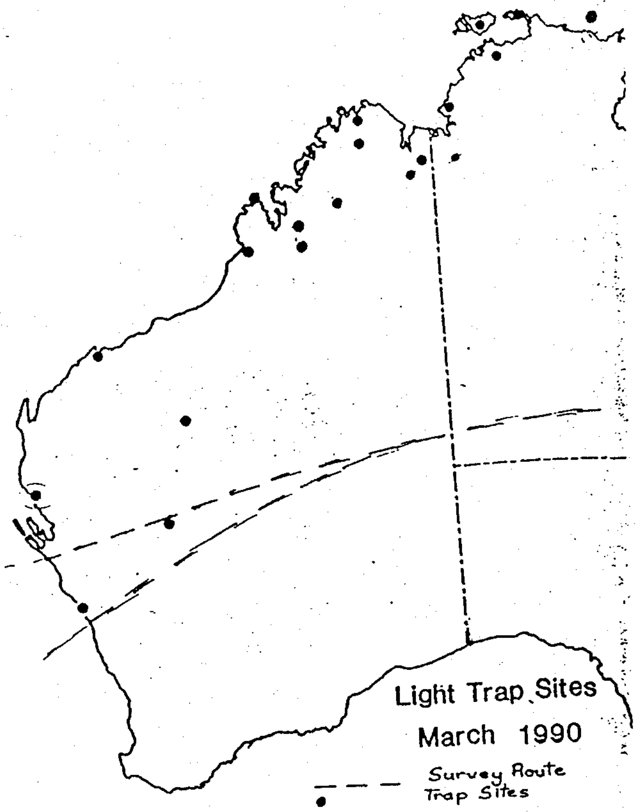
Each month cattle in the sentinel herds are checked for disease, and blood samples are taken for analysis at the Animal Health Laboratory in South Perth.

The other part of the NAQS bluetongue strategy is a series of light traps.

"We run the light traps on a monthly basis at various locations throughout the Kimberley as well as the Pilbara and southern Pilbara," Mr Curran said.

"The aim of the program is to establish bluetongue-free areas in the sheep producing regions of the State. This is important in maintaining our valuable sheep export trade," Mr Curran said.

Insect traps monitoring bluetongue



NORTH Queensland is playing a vital role in Australia's bluetongue monitoring program.

Bluetongue is a virus disease of sheep and cattle which, along with foot and mouth disease and rinderpest, is one of the three most feared exotic livestock diseases Australia faces.

Several strains of bluetongue are already present in Australia, but so far these viruses have not caused any major livestock problems.

As a precaution State and Commonwealth governments have set up and are monitoring a chain of sentinel cattle herds across the country.

Each state is responsible for maintaining its own set of sentinel herds and 20 of these are in Queensland.

Staff monitoring the sentinel cattle take blood samples from the stock at regular intervals to check for the presence of bluetongue and related viruses.

The DPI's Oonoonba laboratory monitors blood samples from the sentinel herds in Queensland, five herds in the Northern Territory and five herds in the north of Western Australia.

Bluetongue is spread by biting insects such as midges. These pests are known as insect vectors.

In addition to carrying bluetongue, these vectors also spread virus diseases which cause ephemeral fever and akabane in cattle.

The CSIRO Division of Tropical Animal Health's Longpocket laboratories, in Brisbane, and the DPI's Oonoonba laboratory have begun a series of surveys of Australia to determine what species of bluetongue vectors are present here.

From these surveys, the scientists hope to establish the distribution patterns of the insect vendors. These surveys are to be carried out once a year.

The first vehicle survey from Oonoonba began in February. More than 17000 kilometres was covered over five weeks by scientists looking for suitable field sites to set up vector traps.

By monitoring these traps the scientists hope to establish the distribution of the biting insect vectors.

Local landholders and government officers will operate the traps and any insects caught will be preserved in alcohol and sent back to Oonoonba for positive identification.

The two vectors causing the most concern with animal health authorities and producers are 'Culicoides wadai' and 'Culicoides brevitarsis'.

The authorities feel the dangers of bluetongue to the sheep industry make it essential for Australia to have a early warning system in place for the possible entry of these Timorese species of 'Culicoides' in Australia.

Identifying and locating bluetongue vectors may also effect Australia's live sheep export trade.

Some countries are insisting sheep for export only come from areas free of bluetongue viruses or bluetongue vectors.

The trapping surveys will help to determine these safe areas.

Bill Doherty, an entomologist at Oonoonba, and Dean Gibson, a senior technical officer with the CSIRO, left on the survey in late February.

They established 'Culicoides' surveillance between Normanton, Hughenden and McKinlay.

As a result of their work Australia now has a network of surveillance traps organised to pick up any early incursions of 'Culicoides' midges into the north.

Coolroom advice

A BOOK dealing with a fast, cost-effective way to cool produce has been released by the DPI.

Entitled "Forced-Air Cooling", it is an essential tool for designers and installers of forced-air cooling systems for fruit and vegetables.

"Forced-air cooling is a fast and cost-effective way to cool produce to its recommended storage temperature," first edition author John Watkins said.

"This book is a design manual and is also an excellent text book for students of horticulture and of refrigeration."

Topics include the general principles of forced-air cooling, diagrams illustrating forced-air cooling systems, essential information needed to design a forced-air cooler, and guidelines for selecting equipment.