## ECOLOGY, BEHAVIOR AND BIONOMICS

# Comparison of the Efficiency of Flight-Interception Trap Models for Sampling Hymenoptera and Other Insects

WELLINGTON G. CAMPOS[1], DÉBORA B.S. PEREIRA[1] AND JOSÉ H. SCHOEREDER[2]

[1]DCNAT/FUNREI, 36300-000, São João del Rei, MG.
e-mail: wgcampos@funrei.br
[2]DBG/UFV, 36571-000, Viçosa, MG.

---

An. Soc. Entomol. Brasil 29(3): 381-389 (2000)

Comparação da Eficiência de Modelos de Armadilhas de Interceptação de Vôo na Amostragem de Hymenoptera e Outros Insetos

RESUMO – Armadilhas de interceptação de vôo para insetos propostas por Townes (1972) e Masner & Goulet (1981) foram modificadas. Os modelos originais e os modificados foram comparados entre si em sua eficiência na amostragem de ordens de Insecta e famílias de Hymenoptera. O uso de bandejas pintadas na cor amarela aumentou significativamente a eficiência de captura das armadilhas de Masner & Goulet. A união, em uma única armadilha, da bandeja amarela, típica do modelo de Masner & Goulet, com o pote, típico das armadilhas Malaise, não reduziu a eficiência individual dos dois sistemas. A associação desses sistemas de captura por interceptação de vôo, mais a atratividade da cor amarela, permitiu o funcionamento, num mesmo local e ao mesmo tempo, de três técnicas que geralmente têm sido empregadas isoladamente. O resultado foi o somatório de amostras padronizadas, sem perda de eficiência individual. Um menor esforço humano é possível, porque reduz a quantidade de armadilhas. O custo financeiro também é menor, devido à economia de tecido utilizado. Como uma técnica compensa a menor eficiência da outra na captura de determinados taxa, um modelo de armadilha que associa todas elas pode ser particularmente útil em levantamentos faunísticos abrangentes.

PALAVRAS-CHAVE: Insecta, armadilha Malaise, parasitóides, metodologia amostral, levantamento faunístico.

ABSTRACT - Models of insect flight traps designed by Townes (1972) and Masner & Goulet (1981) were modified. The original and the modified models were compared in their effectiveness in sampling orders of Insecta and families of Hymenoptera. The use of yellow painted trays strongly improved the effectiveness of the trap proposed by Masner & Goulet (1981). Joining in a same trap a yellow tray, typical of Masner & Goulet models, with a pot, typical of Malaise traps, did not reduce the individual effectiveness of each system. The association of such flight interception trap models, added to the attractiveness of the yellow color allowed the operation, at the same time and place, of the three techniques that have usually been employed apart. The result was the summation of standardized samples, without loss of individual effectiveness. A smaller human effort was demanded, because the maintenance and the handling of a larger number of traps were reduced. The financial cost was also smaller, considering the fabric economy. This associated model is indicated for large faunistic surveys because one technique compensates the lower effectiveness of the other in catching some taxa.

KEYWORDS: Insecta, Malaise traps, parasitoids, ecological methods, faunistic survey.

---

The effectiveness of the employed sampling method has a strong effect on the quantification of an ecological community. In a faunistic survey, one might request more than representatives of all the existent taxa of interest in a given site. In that case, it is necessary the sampling method to be able to reveal the relative abundances. The human effort and the financial cost of the method also need to be minimized. However, habits vary thoroughly from one taxon to another, and the effectiveness of the method hardly will be the same for all of them. The method will also be more or less efficient depending on the habitat, as for example different kinds of vegetation. In spite of the difficulties and importance of obtaining good samples of insect assemblages, there are not many comparative studies of sampling methods for Insecta (Canaday 1987) and its superior taxonomic categories, including Hymenoptera (Noyes 1989). In fact, it seems that a method that captures all the families of Hymenoptera with the same effectiveness does not exist (Noyes 1982).

From the original model of flight-interception trap proposed by Malaise (1937), modifications have been made trying to assist varied situations and several purposes (Steyskal 1981). To all those variant models have been indistinctly given the generic name Malaise traps. Entomologists have emphasized their potential of capture and easiness of use (Gressit & Gressit 1962, Evans & Owen 1965, Mathews & Mathews 1971 1983, Townes 1972, Darling & Packer 1988, Ellis & Thomas 1994). Malaise traps offer the following advantages: easy making, low cost, capture flying insects during the whole time and dispense the presence of the collector for one week or more. Malaise traps have been particularly indicated for Hymenoptera (Darling & Packer 1988), Diptera (Strickler & Walker 1993) and Thysanoptera (Olsen & Midtgaard 1996), but they can capture other orders relatively well (Basset & Springate 1992, Dutra & Marinoni 1994, Ellis & Thomas 1994). The mechanism of flight interception has also been used to catch Coleoptera (Owen 1993).

Inspired by Malaise traps and by the model proposed by Peck & Davis (1980) for Coleoptera, Masner & Goulet (1981) proposed a trap that conjugates the flight interception to the insecticide use. The model seems to improve the effectiveness for some microhymenopteran when compared to Malaise traps, although the authors did not present a systematic comparison of them. Brilliant colored traps, mainly yellow, are attractive for many groups of insects (Mound 1962, Lara *et al*. 1976, Lippold *et al*. 1977, Kirk 1984, Moreno *et al*. 1984, Ali 1993, Hesler & Sutter 1993, Jenkins & Roques 1993, Blades & Marshall 1994, Webb *et al*. 1994, Vernon & Gillespie 1995, Moore *et al*. 1996, Tedders *et al*. 1996). Using five different colors to collect Apoidea (Hymenoptera), Ortiz-Sanchez & Aguirre-Segura (1993) verified that the yellow trap caught the largest number of species. Yellow tray traps filled with water and detergent have also captured some families of Hymenoptera of the Parasitica series (Masner 1976, Noyes l989). With the purpose of improving sampling techniques for winged insects, mainly Hymenoptera Parasitica, the effectiveness of four models of flight interception traps was compared.

## Materials and Methods

The following models of flight interception traps were compared:

A) Malaise trap model Townes (1972): The capture principle and operation of Malaise traps are based on the interception of the flight by means of a fabric barrier and subsequent phototropism presented by the insects. The intercepted insects are attracted by the sunlight, at the top of the trap, and they fall inside a pot with alcohol. The presence of the collector can be dispensable for up to one week, after which the pot is replaced. The compared model was made according to the author's indications, except for the fabric and dimensions. The employed fabric *organza* is flexible, light and possesses smaller pores than the fabric employed in the original model, not allowing the passage of minute insects but not impeding the passage of the wind. The area of the vertical barrier of flight interception was of 1.80 m length 1.40 m height. All the other parts being in conformity with this alteration. The dimension of this area was standardized with the areas of interception of the other models described ahead.

B) Model Masner & Goulet (1981): A fabric barrier impregnated with insecticide intercepts the insects, which drop in a tray filled with water and detergent. The traps were built according to the authors, but with an organza interception barrier of 1.80 m x 1.40 m. The collecting trays were made of galvanized foil in the dimension of 1.80 m length 0.60 m width. Unlike the originally recommended use of saturated saline solution, it was used a 2.5% formalin solution as preserver. The intercepting barrier was impregnated with a pirethroid, the insecticide deltamethrin Decis®, 30 ml for 10 l of water.

C) Model Masner & Goulet (1981) modified by the increment of the yellow color to the collecting tray: The traps were built as described in the item B, but the internal surface of the metal trays was painted in brilliant yellow (Fig. 1).

D) Association of the Townes (1972) and Masner & Goulet (1981) models plus the yellow color in the collecting tray: The model results in joining a yellow collecting tray in the bottom of a Townes model, plus the insecticide impregnation in its intercepting barrier (Fig. 2). The insects are caught by the pot at the top and by the tray at the bottom.

The traps were installed at the Estação Florestal de Experimentação e Pesquisa do Instituto Brasileiro do Meio Ambiente e Recursos Renováveis (EFLEX-IBAMA), in Ritápolis County, State of Minas Gerais. The samples were taken in an uniform area with sparse trees and prevailing bushes and herbs. The area was 80 m away from a secondary forest. Four traps of each model were randomly distributed in the area and stayed in the field for two weeks, in the winter of 1995. The traps were installed with their intercepting barriers longitudinally arranged in east-west direction, and the pots facing the sunset.

After the first week, the sampled material was collected and the intercepting barriers were impregnated again with insecticide. The pots containing the insects were replaced, and the liquid of the trays was filtered in paper filters, in which the insects were retained. Filtering the solution in the field avoided the transport of great volume of liquid (30 liters each trap) to the laboratory, and allowed its reuse. In laboratory, the specimens were identified and quantified at the order level. The families of Hymenoptera were subsequently identified and quantified according to the classification of Naumann (1991). The ants, winged or not, were excluded to avoid sampling mistakes due the proximity of nests of some traps. Each replicate was considered the mean of insects weekly caught by each trap, so there were four replicates for each trap model. Data were submitted to ANOVA and the means were compared by the Duncans's test ($P<0.05$).


Figures 1-2. Models of flight-interception traps for insects. 1) Model Masner & Goulet (1981) modified by the increment of the yellow color in the collecting tray. 2) Association of the Townes (1972) and Masner & Goulet (1981) models plus the yellow color in the collecting tray, showing the pot at the top (T) and the yellow tray at the bottom (B).

## Results and Discussion

The trap effectiveness in catching Diptera, Hymenoptera, Homoptera and Thysanoptera was significantly increased when yellow painted trays were used. The yellow color respectively duplicated and triplicated the total amounts of insects and Hymenoptera sampled by the trap model of Masner & Goulet (1981) (Table 1). Although other 20 families of Hymenoptera were poorly sampled, and data are not show in Table 2, eighteen families were sampled in sufficiently high amounts to draw comparisons. Thirteen of these families (72%) responded positively to the yellow color (Table 2). One more extensive sampling, in different seasons and habitats, would probably increase the abundance of those poorly sampled families. Anyway, it was possible to conclude that the use of yellow painted trays strongly improved the effectiveness of the trap originally proposed by Masner & Goulet (1981).

When the effectiveness of the yellow trays at the bottom of the traps (present in the model modified from Masner & Goulet and in the associated model) was compared with the pots at their top (present in the original model of Townes and in the associated model) (Figs. 1, 2), the pots were more efficient only for Diptera and Lepidoptera (Table 1). However, it was the yellow color that also determinated the largest effectiveness of the trays for most families of Hymenoptera (Table 2). As pots and trays sampled better different orders and families, they should be joined together in the same trap.

The association of a yellow tray with a pot in a same trap did not reduce the individual effectiveness of each system. In general, the number of individuals collected by the pots of the conjugated model was not significantly different from the amount obtained by the isolated pots of the original model of Townes (1972). The same was observed among the effectiveness of the trays in the associated model and in the modified model of Masner & Goulet (1981) (Tables 1, 2). The insecticide impregnation in the intercepting barrier of the conjugated trap, seeking to increase the capture by the tray, might reduce the amount of insects captured by phototropism. As this did not happen, it is necessary to investigate the actual need of the insecticide or the effectiveness of the employed product.

The trap model proposed by Townes (1972) associated with the model of Masner & Goulet (1981) plus the increment of the yellow color was more efficient than the isolated original methods (Tables 1, 2). The joining of two flight interception methods with the attractiveness of the yellow color allowed the operation, at the same time and place, of three techniques that have usually been employed apart. The result was the summation of standardized samples, without loss of their individual effectiveness. A smaller human effort was demanded, and the maintenance and handling of a larger number of traps was reduced. The financial cost was also smaller, considering the fabric economy. On the other hand, the collector should be aware that the trays at the bottom of the traps request transport and handle of considerable volume of water. In addition, in rainy days may occur losses of samples due to overflow. Such inconveniences do not exist for the pots. The associated trap can be indicated for obtaining large faunistic samples. On the other hand, if the object of study is a single order or family, the trap could be simplified, because pots and trays sampled better different orders and families.

## Acknowledgements

The employees of EFLEX-IBAMA of Ritápolis (MG) contributed for the field experiment in several ways, and we are particularly indebted to Unit Chief Eng. Forest José Nivaldo de Menezes Carvalho. We thank CNPq for an undergraduate scholarship to DBS Pereira. WG Campos and JH Schoereder are supported by CNPq grants. Anonymous reviewers contributed to improve the manuscript.

Table 1. Means [± SE] of individuals by order of Insecta sampled in four models of flight-interception traps during seven days. Ritápolis (MG), winter of 1995.

| Taxa | Models of traps | | | | | |
|---|---|---|---|---|---|---|
| | Townes (1972)original with a pot at the top | Masner & Goulet (1981) original with a gray tray | Masner & Goulet (1981) modified with a yellow tray | Association Townes (1972) + Masner & Goulet (1981) + yellow tray | | |
| | | | | Pot at the top | Yellow tray at the bottom | Total (pot + tray) |
| Diptera | 1291.8 b | 390.9 d | 690.8 c | 1206.3 b | 765.1 c | 1971.4 a |
| | [± 45.6] | [± 30.2] | [± 84.1] | [± 63.2] | [± 63.6] | [± 113.1] |
| Hymenoptera | 119.9 c | 59.5 d | 199.0 b | 119.4 c | 201.8 b | 316.1 a |
| | [± 17.6] | [± 6.9] | [± 31.7] | [± 12.1] | [± 20.6] | [± 29.1] |
| Homoptera | 39.9 b | 53.3 b | 141.0 a | 33.3 b | 115.9 a | 149.1 a |
| | [± 6.8] | [± 6.5] | [± 21.9] | [± 9.5] | [± 18.6] | [± 28.1] |
| Coleoptera | 12.6 e | 42.5 cd | 63.9 bc | 20.0 de | 90.6 ab | 110.5 a |
| | [± 0.8] | [± 10.5] | [± 14.3] | [± 3.5] | [± 16.4] | [± 16.9] |
| Thysanoptera | 9.5 d | 34.3 c | 77.5 b | 8.8 d | 109.6 a | 118.4 a |
| | [± 1.4] | [± 6.9] | [± 12.8] | [± 3.6] | [± 65.8] | [± 63.3] |
| Lepidoptera | 48.4 b | 8.1c | 10.6 c | 54.6 ab | 10.4 c | 65.0 a |
| | [± 4.7] | [± 2.1] | [± 1.1] | [± 10.4] | [± 0.8] | [± 11.2] |
| Orthoptera | 0.3 b | 13.8 a | 12.1 a | 0.0 b | 12.8 a | 12.8 a |
| | [± 0.1] | [± 3.4] | [± 2.5] | [± 0.0] | [± 3.2] | [± 3.2] |
| Heteroptera | 4.0 cd | 4.9 cd | 6.3 bc | 3.0 d | 7.5 b | 10.5 a |
| | [± 0.3] | [± 0.9] | [± 0.9] | [± 1.1] | [± 1.1] | [± 1.5] |
| Psocoptera | 4.5 b | 2.4 b | 2.5 b | 2.6 b | 4.8 b | 7.4 a |
| | [± 1.0] | [± 0.4] | [± 0.4] | [± 1.2] | [± 1.0] | [± 1.7] |
| Total | 1530.8 b | 609.7 d | 1203.6 c | 1447.8 bc | 1318.4 bc | 2762.2 a |
| | [± 64.2] | [± 23.4] | [± 63.6] | [± 64.6] | [± 66.8] | [± 96.2] |

Means in the same line followed by the same letter did not differ by the Duncan's test ($P < 0.05$), ($n = 4$).

Table 2. Means [± SE] of individuals by family of Hymenoptera sampled in four models of flight-interception traps during seven days. Ritápolis (MG), winter of 1995.

| Taxa | Models of traps | | | | | |
|---|---|---|---|---|---|---|
| | Townes (1972) original with a pot at the top | Masner & Goulet (1981) original with a gray tray | Masner & Goulet (1981) modified with a yellow tray | Association Townes (1972) + Masner & Goulet (1981) + yellow tray | | |
| | | | | Pot at the top | Yellow tray at the bottom | Total (pot + tray) |
| Ceraphronidae | 8.0 c | 6.5 c | 24.5 b | 9.8 c | 37.9 ab | 47.6 a |
| | [± 0.7] | [± 0.9] | [± 3.7] | [± 1.1] | [± 7.3] | [± 7.8] |
| Encyrtidae | 3.8 d | 11.9 c | 49.3 a | 4.1 d | 41.0 b | 46.3 ab |
| | [± 0.6] | [± 2.0] | [± 4.1] | [± 0.8] | [± 1.4] | [± 1.1] |
| Scelionidae | 15.3 c | 9.5 d | 30.4 b | 11.3 cd | 26.8 b | 36.8 a |
| | [± 1.8] | [± 0.7] | [± 1.9] | [± 1.0] | [± 2.5] | [± 2.3] |
| Mymaridae | 19.1 b | 3.5 d | 11.9 c | 13.9 c | 10.9 c | 24.8 a |
| | [± 2.1] | [± 0.7] | [± 0.8] | [± 0.7] | [± 1.4] | [± 1.3] |
| Platygasteridae | 6.6 c | 1.5 d | 10.8 b | 10.8 b | 11.1 b | 21.9 a |
| | [± 0.9] | [± 0.2] | [± 1.1] | [± 1.2] | [± 0.5] | [± 1.5] |
| Diapriidae | 4.6 d | 3.4 d | 10.9 c | 3.9 d | 13.5 b | 17.4 a |
| | [± 0.3] | [± 0.4] | [± 1.4] | [± 0.3] | [± 0.8] | [± 0.6] |
| Braconidae | 9.9 b | 2.0 d | 6.1 c | 10.4 b | 5.8 c | 16.0 a |
| | [± 1.1] | [± 0.6] | [± 0.8] | [± 0.9] | [± 0.9] | [± 0.6] |
| Eulophidae | 5.0 c | 3.6 c | 9.4 b | 5.4 c | 9.6 b | 15.0 a |
| | [± 0.9] | [± 0.4] | [± 0.9] | [± 0.2] | [± 1.5] | [± 1.4] |
| Bethylidae | 10.3 a | 2.3 b | 4.1 b | 9.1 a | 3.8 b | 12.9 a |
| | [± 1.6] | [± 0.3] | [± 0.5] | [± 0.7] | [± 1.3] | [± 2.0] |
| Ichneumonidae | 8.1 b | 1.1 d | 3.9 c | 8.8 b | 3.6 c | 12.4 a |
| | [± 0.7] | [± 0.6] | [± 0.3] | [± 0.8] | [± 0.3] | [± 1.1] |
| Aphelinidae | 3.3 c | 3.4 c | 8.5 ab | 2.6 c | 7.4 b | 10.0 a |
| | [± 0.5] | [± 0.9] | [± 0.5] | [± 0.7] | [± 0.6] | [± 1.1] |
| Trichogrammatidae | 6.4 ab | 0.9 c | 3.4 bc | 5.1 b | 3.9 b | 9.0 a |
| | [± 0.8] | [± 0.3] | [± 1.0] | [± 1.3] | [± 0.7] | [± 1.3] |
| Pompilidae | 0.9 d | 1.3 d | 3.1 bc | 1.6 cd | 3.6 b | 5.3 a |
| | [± 0.4] | [± 0.6] | [± 0.3] | [± 0.7] | [± 0.3] | [± 0.6] |
| Pteromalidae | 2.8 ab | 2.0 bc | 1.8 bc | 2.4 ab | 1.3 c | 3.6 a |
| | [± 0.5] | [± 0.7] | [± 0.3] | [± 0.5] | [± 0.4] | [± 0.1] |
| Sphecidae | 1.4 b | 1.1 b | 3.6 a | 1.4 b | 2.1 ab | 3.5 a |
| | [± 0.5] | [± 0.4] | [± 0.5] | [± 0.5] | [± 0.4] | [± 0.8] |
| Chalcididae | 0.6 d | 0.4 d | 0.8 cd | 1.6 bc | 1.9 b | 3.5 a |
| | [± 0.1] | [± 0.1] | [± 0.1] | [± 0.3] | [± 0.6] | [± 0.4] |
| Eucoilidae | 2.1 ab | 0.6 c | 2.3 ab | 1.5 bc | 1.9 bc | 3.4 a |
| | [± 0.6] | [± 0.2] | [± 0.3] | [± 0.5] | [± 0.1] | [± 0.6] |
| Proctotrupidae | 0.9 a | 0.0 b | 0.3 b | 0.8 a | 0.1 b | 0.9 a |
| | [± 0.1] | [± 0.0] | [± 0.1] | [± 0.1] | [± 0.1] | [± 0.1] |

Means in the same line followed by the same letter did not differ by the Duncan's test ($P < 0.05$), ($n = 4$).

## Literature Cited

**Ali, M.A. 1993.** Influence of trap colors and placement on captures of the hairy rose beetle, *Tropinota squalida* Scop. (Coleoptera: Scarabaeidae). Insect Sci. Appl. 14: 215-219.

**Basset, Y. & N.D. Springate. 1992.** Dial activity of arboreal arthropods associated with a rainforest tree. J. Nat. Hist. 26: 947-952.

**Blades, D.C.A. & S.A. Marshall. 1994.** Terrestrial arthropods of Canadian peatlands: Synopsis of pan trap collections at four southern Ontario peatlands. Mem. Entomol. Soc. Can. 169: 221-284.

**Canaday, C.L. 1987.** Comparison of insect fauna captured in six different trap types in a Douglas-fir forest. Can. Entomol. 119: 1101-1108.

**Darling, D.C. & L. Packer. 1988.** Effectiveness of Malaise traps in collecting Hymenoptera: The influence of trap design, mesh size, and location. Can. Entomol. 120: 787-796.

**Dutra, R.R.C. & R.C. Marinoni. 1994.** Insetos capturados com armadilha Malaise na Ilha do Mel, Baía de Paranaguá, Paraná, Brazil. I. Composição de ordens. Rev. Bras. Zool. 11: 227-245.

**Ellis, W.N. & R.T.S. Thomas. 1994.** Insect phenology and diversity in Malaise traps at the Veluwe. Entomol. Ber. 54: 171-175.

**Evans, F.C. & D.F. Owen. 1965.** Measuring insect flight activity with a Malaise trap. Pap. Mich. Acad. Sci. Arts Lett. 1: 89-94.

**Gressitt, J.L. & M.K. Gressitt. 1962.** An improved Malaise trap. Pac. Insects 4: 87-90.

**Hesler, L.S. & G.R. Sutter. 1993.** Effect of trap color, volatile attractants, and type of toxic bait dispenser on captures of adult corn rootworm beetles (Coleoptera: Chrysomelidae). Environ. Entomol. 22: 743-750.

**Jenkins, M.J. & A. Roques. 1993.** Attractiveness of color trap to *Strobilomyia* spp. (Diptera: Anthomyiidae). Environ. Entomol. 22: 297-304.

**Kirk, W.D. 1984.** Ecologically selective colored traps. Ecol. Entomol. 9: 35-41.

**Lara, F.M., S.A. Bortoli & E.A. Oliveira. 1976.** Atratividade de cores a alguns insetos associados a *Citrus* sp. An. Soc. Entomol. Brasil 5: 157-163.

**Lippold, P.C., T. Hongtrakula, S. Thongdeetaa, H. Banziger, P.E. Hillerup, W. Keldermann, P. Supharngasen & P. Deema. 1977.** Use of colored sticky board traps in insect surveys. Plant Prot. Serv. Tech. Bull. 29. 60p.

**Malaise, R.A. 1937.** A new insect-trap. Entomol. Tidskr. 38: 148-160.

**Masner, L. 1976.** Yellow pan traps. Proctos 2: 2.

**Masner, L. & H. Goulet. 1981.** A new model of flight-interception for some hymenopterous insects. Entomol. News 92: 199-202.

**Mattheus, R.W. & J.R. Mattheus. 1971.** The Malaise trap: Its utility and potential for sampling insect populations. Mich. Entomol. 4: 117-122.

**Mattheus, R.W. & J.R. Mattheus. 1983.** Malaise traps: Townes model catches more insects. Contrib. Amer. Entomol. Inst. 20: 428-432.

**Moore, T.R.E., J.E. Slosser, J. Cocke &**

**W.H. Newton. 1996.** Effect of trap design and color in evaluating activity of *Tabanus abactor* Philip in Texas Rolling Plains habitats. Southwest. Entomol. 21: 1-11.

**Moreno, D.S., W.A. Gregory & L.K. Tanigoshi. 1984.** Flight response of *Aphytis melinus* (Hymenoptera: Aphelinidae) and *Scirtothrips citri* (Thysanoptera: Thripidae) to trap color, size and shape. Environ. Entomol. 13: 935-940.

**Mound, L.A. 1962.** Studies on the olfaction and color sensitive of *Bemisia tabaci* (Genn.) (Homoptera: Aleyrodidae). Entomol. Exp. Appl. 5: 99-104.

**Noyes, H.S. 1982.** Collecting and preserving chalcid wasps (Hymenoptera: Chalcidoidea). J. Nat. Hist. 16: 315-334.

**Noyes, H.S. 1989.** The study of five methods of sampling Hymenoptera (Insecta) in a tropical rainforest, with special reference to the Parasitica. J. Natur. Hist. 23: 285-298.

**Olsen, A.J. & F. Midtgaard. 1996.** Malaise trap collections of thrips from the islands Haoya and Ostoya in Oslofjorden, South Norway. Norwegian J. Entomol. 43: 63-68.

**Ortiz-Sanchez, F.J. & A. Aguirre-Holds. 1993.** Efecto del color sobre las capturas de abejas mediante trampas Moericke en el sur de Espana (Hymenoptera, Apoidea). Graellsia 49: 63-71.

**Owen, J.A. 1993.** Use of a flight-interception trap in studying the beetle fauna of a surrey wood over a three year period. Entomologist 112: 141-160.

**Peck, S.B. & A.E. Davis. 1980.** Collecting small beetles with large area "window" traps. Coleopt. Bull. 34: 237-239.

**Naumann, I.D. 1991.** Hymenoptera. p. 916-1000. In: CSIRO (ed.) The insects of Australia: A textbook for students and research works. Vol. I, 2 ed. Melburne University Press, Carlton. 542p.

**Steyskal, G.C. 1981.** A bibliography of the Malaise trap. Proc. Entomol. Soc. Wash. 83: 225-229.

**Strickler, J.D. & E.D. Walker. 1993.** Seasonal abundance and species diversity of adult Tabanidae (Diptera) at Lake Lansing Park-North, Michigan. Great Lakes Entomol. 26: 107-112.

**Tedders, W.L., R.F. Mizell & B.W. Wood. 1996.** Effects of color and trunk-wrap on pecan weevil catch in pyramidal traps. J. Entomol. Sci. 31: 414-419.

**Townes, H.A. 1972.** A light-weight Malaise trap. Entomol. News 83: 239-247.

**Vernon, R.S. & D.R. Gillespie 1995.** Influence of trap shape, size, and background color on captures of *Frankliniella occidentalis* (Thysanoptera: Thripidae) in a cucumber greenhouse. J. Econ. Entomol. 88: 288-293.

**Webb, S.E., M.L. Kok-Yokomi & D.J. Voegtlin. 1994.** Effect of trap color on species composition of alate aphids (Homoptera: Aphididae) caught over watermelon plants. Fla. Entomol. 77: 146-154.

*Accepted 30/IV/2000.*