Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
www.entomoljournal.com
JEZS 2020; 8(4): 409-412

Received: 08-05-2020
Accepted: 10-06-2020

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Occurrence of pests on selected smoked fish families in Benue state

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Abstract
The study was to determine the occurrence of pests on selected smoked fish families in Benue state. The common pests identified in the study area were *Dermestes maculates, Necrobia rufipes* and Blow flies and the selected smoked fish families were *Claridae, Protopteridae, Characidae* and *Mormyridae*. The selected fish families were stored for every 3 months in 2 years and the result of the study revealed that *Dermestes maculates* occurred 51.30%, 52.55%, 52.02% and 53.90%, *Necrobia rufipes* occured 35.86%, 35.98%, 38.02% and 36.87% while Blow flies occurred 12.84%, 11.47%, 9.97% and 9.22% on the samples of *Clariidae, Protopteridae, Characidae* and *Mormyridae* fish families respectively. In all the selected markets and selected fish families the preference of occurrence of *Dermestes maculates* was the highest, *Necrobia rufibes* was second while Blow fly was the least. In conclusion *Dremestes maculates* was the predominant pest followed by *Necrobia rufibes* and Blowfly was the least.

Keywords: Preference, occurrence, specific, pests and smoked fish

Introduction
The smoked fish in Nigeria's major source of damage is insect infestation. The major pests found on dried fish in Nigeria according to[1] and [2] are Dermestes species and Necrobia rufipes. The research of [3] reported that beetles of the family Dermestidae invade fish from the earliest stages of drying and breed in the dried product and are also associated with spread of anthrax and contaminants of insect origin in the foodstuffs of some countries, resulting in market value reduction for fish vendors. The insect infestation according to [4] was the cause of most prominent losses in quality and quantity of stored, dried and smoked fish in Nigeria.
A research by [5] reported that processing and preservation methods slow down fish spoilage, preserve its quality and also extend fish shelf life.[6] also reported that several processing and preservation methods have been considered and used to prevent fish from spoilage including; salting, sun drying, solar drying and canning. Processed fish is a traditional part of diet of a large section of a world's population as reported by [7]. However according to [8] the gap between the demand and supply of processed fish products is widening due to increase in population, poor post harvest handling and lack of storage and processing facilities which are all reasons for decline in fish resources.
The most commonly used method of fish preservation employed in the tropics is smoking which is a traditional fish processing method aimed at preventing or reducing post-harvest losses caused by pest infestation [9].
There are many fish families in the Nigerian waters as reported by [10] and [11]. Four fish families were selected for this study based on their common availability. The fish families selected were Clariidae, Protopteridae, Characidae and Mormyridae. The study is aimed at determining the preference of occurrence of specific pest on specific smoked fish families in Benue State of Nigeria.

Materials and Methods
The 4 selected smoked fish families for determination of occurrence of pests were purchased from the six selected markets (2 from each of the agricultural zones in Benue state; Zone A: Katsina Ala and Adikpo, Zone B: Wadata and Gboko, Zone C: Otukpo and Oju) of the study area. The selected fish families were; Claridae, Protopteridae, Characidae and Mormyridae. Two hundred grams (200g) of the 4 selected smoked fish families were stored for every 3 months (8 times in 2 years).

At the end of every storage period the smoked fish family samples were taken to zoology laboratory of Benue State University for pest identification and counting in order to determine the preference of occurrence on the samples fish families. Simple percentage was used to calculate the percentage of occurrence of pests infesting various smoked fish families. Below is the formula used to calculate the occurrence of pests based on percentage:

$$\text{Percentage of occurrence of pests (\%)} = \frac{\text{No. of a specific species of pests}}{\text{Total No. of various pests}} \text{ X } 100$$

This was calculated for each fish family to determine the occurrence of pests on each of the fish family.

Results

The common pests identified in the study area were *Dermestes maculates*, *Necrobia rufipes* and Blow flies. Table 1 shows the occurrence of pests on selected smoked fish families in the study area. Based on the average of the 6 markets put together the results of the study revealed that *D. maculates* occurred 51.30%, 52.55%, 52.02% and 53.90 % from the samples of *Clariidae*, *Protopteridae*, *Characidae* and *Mormyridae* fish families respectively. Similarly, *N. rufipes* occurred 35.86%, 35.98%, 38.02% and 36.87 % from the samples of *Clariidae*, *Protopteridae*, *Characidae* and *Mormyriddae* fish families respectively. Blow flies occurred 12.84%, 11.47%, 9.97% and 9.22% from the same samples of *Clariidae*, *Protopteridae*, *Characidae* and *Mormyriddae* fish families respectively.

D. maculates had the highest percentage of occurrence on all the fish families in all the markets while Blow flies recording the least percentage of occurrence on all the fish families for all the markets.

Figure 1 shows the results for occurrence of pests on selected smoked fish families in Katsina-Ala fish market. The percentage of occurrence of *D. maculates* in Katsina-Ala was highest (48.82 %) on Protopteridae and lowest (48.21 %) on Characidae. The percentage of occurrence of *N. rufipes* was higher (44.05 %) on both Characidae and Mormyridae and lowest (42.07 %) on Clariidae, while Blow flies in Katsina-Ala was the highest (7.99 %) on Protopteridae and lowest (4.16 %) on Characidae.

Figure 2 shows the results for occurrence of pests on selected smoked fish families in Adikpo fish market. The percentage of occurrence of *D. maculates* in Adikpo was highest (49.52 %) on Clariidae and lowest (41.48 %) on Mormyridae. *N. rufipes* percentage of occurrence was highest (40.67%) on Characidae and lowest (36.19 %) on Clariidae, while the percentage of occurrence of Blow flies was highest (14.29 %) on Clariidae and lowest (8.85 %) on Mormyridae.

Table 1: Occurrence (%) of pests on selected smoked fish families in the study area

Fish Family	*D. maculates*	*N rufipes*	Blow flies
Clariidae	51.30	35.86	12.84[a]
Protopteridae	52.55	35.98	11.47[ab]
Characidae	52.02	38.02	9.97[bc]
Mormyridae	53.90	36.87	9.22[c]
p-value	0.077	0.397	0.000

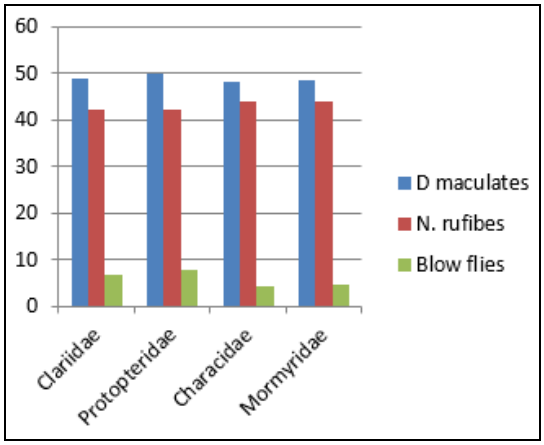

Fig 1: Occurrence (%) of pests on selected smoked fish families in katsina-ala fish market (Zone A)

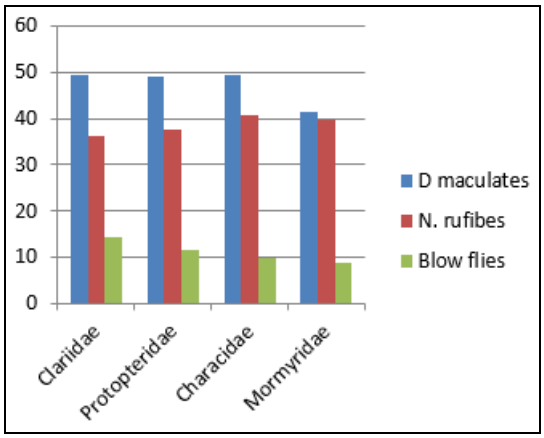

Fig 2: Occurrence (%) of selected pests on selected smoked fish families in adikpo fish market (Zone A)

Figure 4 shows the results for preference of occurrence of specific pest on specific smoked fish families in Gboko fist. The percentage of occurrence of *Dermestes maculates* in Gboko was highest (53.87 %) on Mormyridae and lowest (47.81 %) on Clariidae. *Necrobia rufipes* percentage of occurrence was highest (38.48 %) on Protopteridae and lowest (37.80 %) on Characidae while the percentage of occurrence of Blow flies was the highest (14.33 %) on Figure 3 shows the results for occurrence of pests on selected smoked fish families in Wadata fish market. The percentage of occurrence of *D. maculates* and *N. rufipes* occurred highest (58.92 and 33.27 %) on Mormyridae. *D. maculates* occurred lowest (53.00 %) on Claridae while *N. rufipes* occurred lowest (29.62 %) on Protopteridae. Blow flies occurred highest (14.31 %) on Clariidae and lowest (9.82 %) on Mormyridae.

Figure 4 shows the results for occurrence of pests on selected smoked fish families in Gboko fish market. The percentage of occurrence of *Dermestes maculates* in Gboko was highest (53.87%) on Mormyridae and lowest (47.81%) on Clariidae. *Necrobia rufipes* percentage of occurrence was higher (38.48 and 38.15%) on Protopteridae and Mormyridae respectively and lower (37.85 and 35.80%) on Clariidae and Characidae respectively, while the percentage of occurrence of Blow flies was the highest (14.33%) on Clariidae and lowest (7.98 %) on Mormyridae.

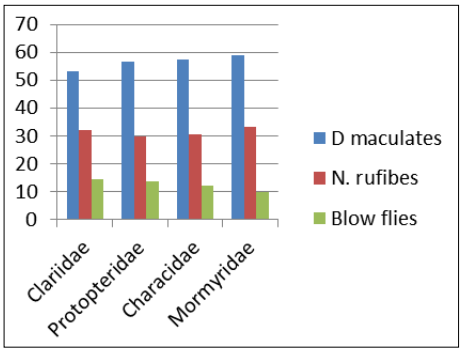

Fig 3: Occurrence (%) of pests on selected smoked fish families in wadata fish market (Zone B)

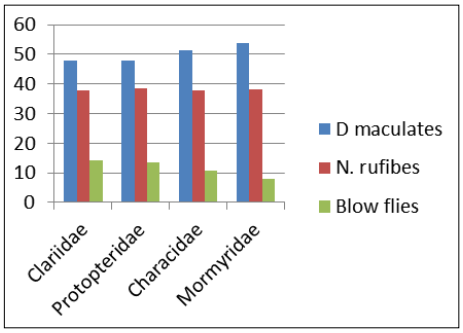

Fig 4: Occurrence (%) of pests on selected smoked fish families in gboko fish market (Zone B)

Figure 5 shows the results for occurrence of pests on selected smoked fish families in Otukpo fish market.

The percentage of occurrence of *D. maculates* in Otukpo was highest (53.73 %) on Characidae and lowest (51.40 %) on Mormyridae. *N. rufipes* percentage of occurrence was highest (41.74 %) on Mormyridae and lowest (36.14 %) on Clariidae while Blowflies was the highest (11.92 %) on Clariidae and lowest (5.97 %) on Characidae.

Figure 6 shows the results for occurrence of pests on selected smoked fish families in Oju fish market. The percentage of occurrence of *D. maculates* in Oju was highest (56.91 %) on Protopteridae and lowest (48.08 %) on Mormyridae. *N. rufibes* percentage of occurrence was highest (40.20 %) on Mormyridae and lowest (31.22 %) on Protopteridae, while the percentage of occurrence of Blow flies was highest (13.30 %) on Characidae and lowest (10.00 %) on Mormyridae.

As presented in Table 1, the overall preference occurrence of specific pests on specific smoked fish in the study area revealed that *D. maculates* accounted for more than half of the total pest infestation for all the fish families viz: *Clariidae* (51.30 %), Protopteridae (52.55 %), *Characidae* (52.02 %) and Mormyridae (53.90 %).

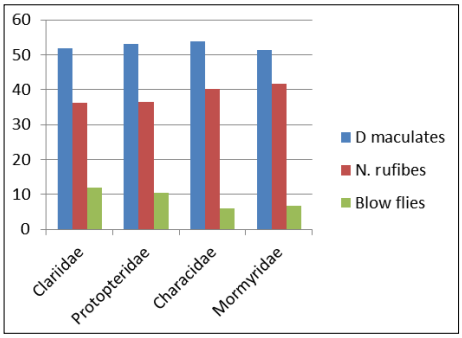

Fig 5: Occurrence (%) of pests on selected smoked fish families in otukpo fish market (Zone C)

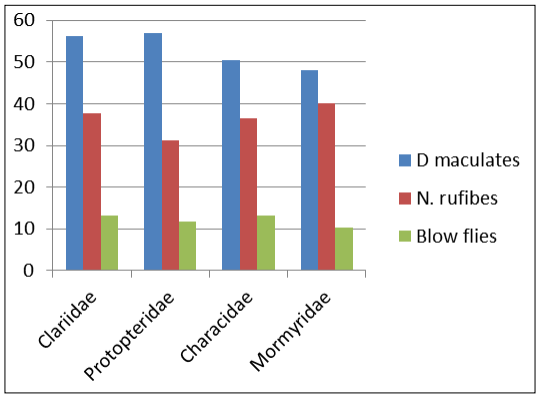

Fig 6: Occurrence (%) of pests on selected smoked fish families in oju fish market (Zone C)

Discussion

The results of the study show that among the infested pests *Dermestes maculates* occurred more than half percent of the total pest infestation for all the fish families viz: *Clariidae* (51.30%), Protopteridae (52.55%), *Characidae* (52.02%) and Mormyridae (53.90%). *Necrobia rufipes* ranked second on all the selected fish; *Clariidae (*35.86%), Protopteridae (35.98%), *Characidae* (38.02%) and Mormyridae (36.87%) respectively. Blow flies ranked the least among the pests on the fish in the study area. Blow fly occurred 12.84% on Claridae, 11.47% on Protopteridae, 9.97% on Characidae and 9.22% on Mormyridae. The second rank of occurrence of *Necrobia rufipes* is in agreement with [12] who worked on investigation of insect pests on three species smoked fish in Mubi North-Eastern Nigeria. Also, the results for individual markets revealed that the percentage prevalence of *D. maculates* in all the markets was highest. Blow flies recorded the least percentage prevalence in all the markets respectively.

The level of pest infestation of smoked fish by *D. maculates* might be attributed to mixing of the old and newly purchased fish in storage; inadequate smoking by fish processors and mixing of properly smoked fish with other commodities like hides and skins, grains and groundnuts during transportation. The likelihood of cross-infestation would be high [2]. The high infestation and corresponding economic damage to smoked fish has been acknowledged worldwide [1, 13]. The level of infestation of the smoked fish by *D. maculates* might be directly related to the storage length of the fish, as the fish vendors purchase smoked fish in bulk and do not buy new stock until the old stock is completely disposed.

This observation corroborates with [14, 15], who reported that long storage periods allowed insects more time to breed and consume the fish. This result is also in agreement with [16] who worked on susceptibility of three fish species to *D. maculates* (Degeer: Coleoptera: Dermestidae) and *N. rufipes* (Degeer: Coleoptera: Cleridae) in Maiduguri and reported that there were significant differences in the mean percentage weight loss due to the activity of *D. maculates* and *N. rufipes* among fish species and that Clarias spp sustained the highest weight loss among the 3 species. The low infestation of the smoked fish by blowfly in this work is in agreement with the research work of [17] that reported that only *D. maculates* and *N. rufipes* associated with dried fish products were identified.

Conclusion

This study has shown that the fish samples *Clariidae*, *Protopteridae*, *Characidae* and Mormyridae samples obtained from the six fish markets in the three Agricultural zones in

Benue State, Nigeria were infested by three common pests: *Dermestes maculates*; *Necrobia rufipes* and Blow flies. *Dermestes maculates* was the predominant pest throughout the year, followed by *Necrobia rufipes* and Blow flies. This trend was observed in all the samples obtained from the three Agricultural zones.

Acknowledgement
The centre for Food Technology and Research (African Center of Excellence) in Benue State University, Makurdi, Benue State of Nigeria is highly appreciated for monitoring this work to ensure its success. We also appreciate the Head of Department, Biological Sciences for providing laboratory and equipment that were used for this work.

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