Original Research Article

EPA, DHA, ADG, AND FCR IN BIOFLOC CATFISH FOR IMPROVING QUALITYOF THE NUTRIENT WITH FISH OIL ADMINISTRATION

ABSTRACT

This research aims to determine the dose for fish oil that is right for improving the growth, viewed from Omega-3 (EPA and DHA), average daily growth (ADG), and feed conversion ratio (FCR). This research was conducted in September and October 2021 in Green House Ciparanje, Padjadjaran University. Method used was experimental method using Completely Randomized Design, having four repetition treatments with different fish oil administrations, namely 0% (A) as control, 2% (B), 4% (C), and 6% (D). Feed given was commercial pellet from Hi-Provite 781 brand. Fish oil used was taken from swordfish. Parameters observed were omega-3, ADG, FCR, and water quality. Research shows the result that optimum fish oil administration for improving EPA/DHA, ADG, and FCR was 4%, with EPA/DHA at 148.5/36 mg/100g, ADG at 0.45%, and FCR at 1.2%. Meanwhile, quality of the water was still in the limitation as suggested in the aquaculture using biofloc.

Keywords: Catfish, Omega-3, ADG, FCR

1. INTRODUCTION

Nowadays, aquaculture has been an alternative capable of competing with capture fisheries in terms of production. Aquaculture is increasingly performed to meet the market demand that is larger toward the fishery product. In Indonesia, fish becomes a food need that is very important in terms of its availability. Fish has protein, vitamin, fat, and mineral that are excellent and prospective for fish's body (Panagan et al., 2011).

However, problem that frequently occurs in the aquaculture is production that is sometimes not the same, in which it is affected by the aspects in cultivation implementation, particularly in the feeding. According to (Madinawati et al., 2011), feed that can meet the need for nutrient in fish can improve the growth in juvenile fishes until reaching a size that is ready for sale. Growth and survival of juvenile fishes are determined by quality of parent, egg, and water as well as ratio between feed and density (Rihi, 2019). Feed is one of the factors determining the success of cultivation business (Telaumbanua, 2018).

Feeding is closely related to the growth and nutrient in fish. Fish growth can be viewed based on average daily growth (ADG) and food conversion ratio (FCR). They are indicators to assess how fast the growth of fish cultivated. Nutrient in feed can affect the growth of fish. Fish belongs to the foodstuff having the highest omega-3 fatty acid (Pratiwy and Pratiwi, 2021).

The ω-3 fatty acid is derivative from essential fatty acid precursor, linolenic and linoleic. The ω-3 fatty acid is grouped into essential fatty acid; it is called essential fatty acid because it cannot be produced in the body, while it is obtained from the food we consume (Rasyid, 2003). The precursor belongs to the elongation and desaturation processes resulting in three fatty acids, namely alpha-Linolenic acid (LNA), eicosapentaenoate acid (EPA), and docosahexaenoate acid (DHA) (Diana F M, 2012).

Omega-3 is frequently found in fish oil. Fish oil has been known worldwide. Fish oil has 25% of saturated fatty acid and 75% of unsaturated fatty acid (Panagan et al. 2011). The ω-3 fatty acid is frequently found in fishes having EPA and DHA (Vilka, 2008). Fish is not the main source of omega-3 fatty acid, but sea microorganism that is its food, namely diatom, dinoflagellate, and chlorella that is plankton.

One of the freshwater fishes for consumption having economic value and easiness to be cultivated is catfish. Advantages of catfish are fast growth, relatively easy breeding, and resistance to the environment that is less desirable, and high nutrient, thus preferred by people (Banjarnahor et al., 2015). Administration of fish oil at different levels will result in different composition of fatty acid in fish body. According to Istiqomah et al. (2017), adding lemuru fish oil in feed with concentration of 4-8% can increase ω-3 fatty acid in fishes.

The use of biofloc system in pisciculture has various benefits, namely enriching microbe or bacterium advantageous in the fish cultivation media, thus suppressing the poisonous compounds (e.g., ammonia), improving and maintaining the stability of water quality, and suppressing the development of disadvantageous bacterium. Thus, fish can grow well (Suprapto 2013). Furthermore, according to a research by Faridah et al. (2019), catfish cultivation using the biofloc system can suppress the death rate until only 18.75% and nutrient absorption by 25%.

Based on the fact, this research aims to determine the dose for fish oil that is right for improving the growth, viewed from Omega-3 (EPA and DHA), average daily growth (ADG), and feed conversion ratio (FCR).

2. METHODS

This research was conducted for four weeks in September 2021 in Green House Ciparanje, Padjadjaran University.

2.1 Test Feed

Feed had four treatments with different fish oil addition, namely 0% (A) as control, 2% (B), 4% (C), and 6% (D). Feed used was commercial pellet from Hi-Provite 781 brand. Fish oil used was swordfish oil purchased from e-commerce. Fish oil was mixed into feed that has been set by 3% of whole weight in test fish and progol as feed adhesive.

2.2 Pisciculture

Test fish used was *Clarias sp.* fish that was the result of cultivation from the cultivator in Cileunyi village. 240 fishes with weight of 20.04 gram and average length of 14 cm were randomly placed into 16 fiber tubs based on treatment, while every tub was for 15 fishes. Size of the fiber tub used was 68x68x68 cm^3 as breeding container. For installation, blower was used as tool for aeration, heater for regulating temperature to be constant, and aeration hose. Water quality was tested using thermometer to measure water temperature, pH meter

was used for measuring pH in water, and Sera Test was used for checking NH_3/NH_4, NO_2 and NO_3 in the breeding media. Tools used in the research were digital scale, scoop, millimeter block, stationary, and documentation tool (mobile phone), ziplock, and label.

Fishes were acclimatized first to the environmental condition. Feeding was performed every day at morning (08.00 a.m.) and evening (16.00 p.m.). Fish growth was measured once a week along with the addition of biofloc molasses and paraque once to twice a week.

2.3 Biofloc Making

Procedures for making bioflock were as follows: (1) Preparation of tool and material to be used (e.g., fiber tub and aeration) by cleaning it first, (2) 1 gram of Probiotics from Paraqua brand was directly dissolved into pool, (3) fiber tub that has been ready was filled with 143 litre of water and given aeration, 3 gram of feed and 90 gram of molasses were poured, probiotics were given, and (4) biofloc breeding media was left for 1-5 days. Flock was formed as marked with clot in breeding media.

2.4 Observation Parameter

2.4.1 Average Daily Growth (ADG)

Fish test was calculated using the equation formula as stated by Jensen (1992).

$$ADG = \frac{\text{ABW } 2 - ABW\ 1}{t}$$

Where.
ABW 2 = Average weight in second *sampling* or the next (gr/fish)
ABW 1 = Average weight in first *sampling* or previous (gr/fish)
t = Interval of *sampling* (day)

2.4.2 Feed Conversion Ratio (FCR)

According to Tacon (1987), feed conversion ratio formula was as follows:

$$\text{FCR} = \frac{F}{(Wt + D) - Wo}$$

Where.
Wt = Final fish weight (g)
Wo = Initial fish weight (g)
D = Dead fish weight (g)
F = Amount of feed consumed (g)

2.4.3 Omega-3

Omega-3 fatty acid was tested in the Laboratory Saraswanti Indo Genetech using GC method, and descriptively analyzed.

2.4.4 Water Quality

Water quality was tested for its temperature, pH, DO, nitrite, nitrate, and ammonia.

3. RESULTS AND DISCUSSION

3.1 Omega-3

Result of omega-3 fatty acid analysis is shown in Table below.

Table 1. Omega-3 fatty acid in catfish

NO.	Parameter (mg/100g)		
	Treatment	EPA	DHA
1	Fish without adding fish oil	16.7	69.9
2	Fish added with fish oil by 4%	36	148.5

Result above shows that nutrient in catfish with and without treatment of 4% had different levels of omega-3 fatty acid, because of the addition of fish oil in feed at different levels. Treatment without oil only had 16.7 mg/100g of EPA and 69.9 mg/100g of DHA. Meanwhile, treatment with the addition of fish oil by 4% had 36 mg/100g of EPA and 148.5 mg/100g of DHA. Result of EPA and DHA in the addition of fish oil by 4% in feed exceeded twice of the result without fish oil.

Omega-3 fatty acid in fish has role that is very important in body. Thus, fish oil is additional substance in feed for growth. Furthermore, fatty acid also plays a role in reproduction, in which successful reproduction is determined by fat as required by the parent and embryo development (Pangkey, 2011).

The increase of EPA and DHA by twice also improved the nutrient in catfish, while human body can get nutrient from consuming catfish. Nutrient has an important role in the growth and development processes in children and human being of all ages. The lack of omega-3 fatty acid can obstruct physical health, brain growth, vision, and neural problem (Diana F M, 2012).

3.2 Average Daily Growth (ADG)

Result of Average Daily Growth (ADG) in catfish during the breeding period shows that concentration of fish oil had average weight gain that was different for every treatment. Average weight was approximately between 0.38-0.45%. The highest treatment was treatment C (4%) by 0.45%, while the lowest was in treatment D (6%) by 0.32%. Mukti (2014) stated that feed given during the experiment has met the primary need of fish for its body and growth. Meanwhile, according to Puteri et al. (2020), not all foods in water are used for growth, while most of energy from food is used for breeding, growth, reproduction, and the rest for activities

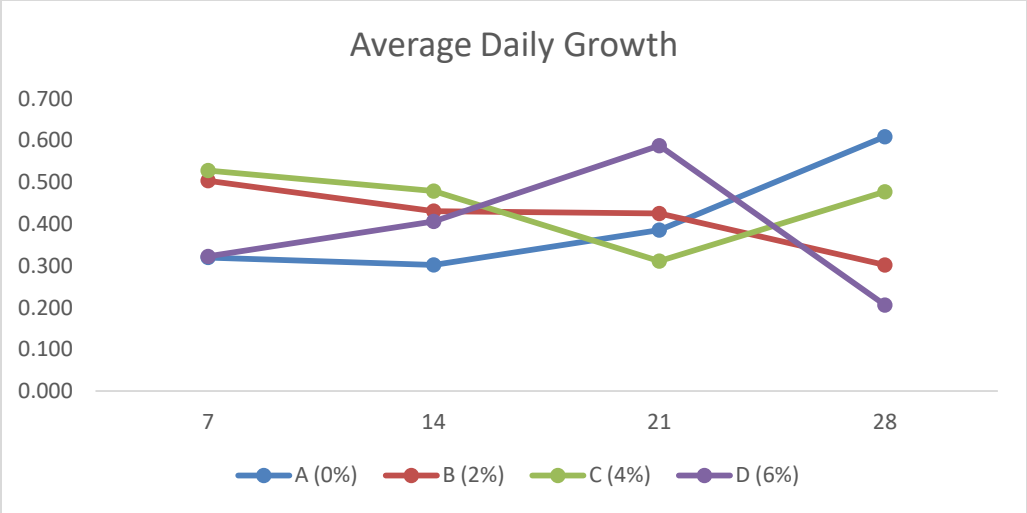

Fig 1.Diagram of Average Daily Growth in Catfish

Weight gain in every treatment was because of fat in artificial feed used as the source of power, thus making growth optimal and weight gain larger (Munisa, et al., 2017). Catfish required 4-5% of fat from feed weight (DKPP, 2018). Excessive administration of fish oil or fat can reduce growth as shown in treatment D (6%). Fat is also a source of energy in fish, while the maximum use of fat in feed can make fish grow faster and result in protein sparing effect (Beamish and Medland, 1986). According to Sanjayasari et al. (2010), protein sparing effect can balance the use of fat and carbohydrate for metabolism activities, so body maintenance is not only based on protein.

3.3 Feed Conversion Ration (FCR)

Feed conversion is comparison between amount of feed given and weight in fish resulted. The use of fish oil at different concentration resulted in various feed conversion ratios. The research shows the result that feed conversion ratio was approximately between 1.20 and 1.40%. The highest feed conversion ratio was in treatment D (6%) at 1.4%. Meanwhile, the lowest efficiency in feeding was in treatment C (4%) at 1.2%.

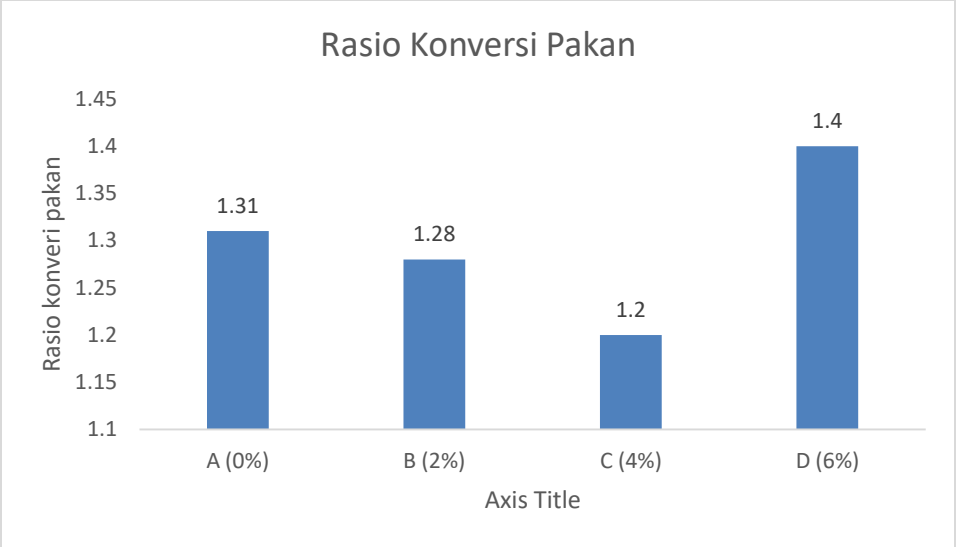

Fig 2. Diagram of Feed Conversion Ratio in Catfish

Feed conversion is affected by feed nutrient absorption in digestive tract. Digestive tract in fishes has microorganism capable of absorbing nutrient (Ardita et al. 2015). When feed conversion value is lower, efficiency in the feed use will be better. When feed conversion is large, feed efficiency level is less desirable. Thus, feed conversion describes the feed use efficiency achieved (Iskandar et al 2014). It is supported by a statement from Sulawesty et al. (2014); when the value is lower, it indicates that food can be used in body better and providing larger body weight gain.

High feed conversion ratio in treatment D (6%) was supposedly caused by excessive fat or fish oil. Excessive fat in feed will cause fat accumulation and heart degeneration in cultivated fish (Robert, 1989). It shows that feed given with fish oil results in good feed conversion ratio when fish oil concentration is in accordance with the need for nutrient in catfish.

3.4 Water Quality

Water quality is one of the aspects that must be considered in the cultivation since it can affect development and growth in fish. Breeding used the biofloc technology. During the research period, measurement was conducted on parameters of water quality, namely temperature, pH, dissolved oxygen, nitrite, nitrate, and ammonia.

Table 2. Water Quality

Parameter	Unit	Range Value
Temperature	^{o}C	26-30
pH		6.4-6.59
Dissolved Oxygen	mg/L	6.0-6.64
Nitrite	mg/L	0-1
Nitrate	mg/L	0-25
Ammonia	mg/L	0-0.25

Temperature in water is affected by production in cultivation, thus being an environmental factor that must be considered. Water will regulate control of temperature in organism's body (Boyd, 2015). Temperature also affects response of fish consumption to the feed given. The result of measurement on temperature in breeding tub was approximately 26-30^{o}C, while the range was still in the default value according to Indonesian National Standard for catfish that is 25-30 ^{o}C.

Dissolved oxygen is used by all living organisms for respiration, substance exchange, or metabolism process that will produce energy for breeding and growth (Pariwono, 2005). Result of measurement on dissolved oxygen during the research period was approximately 6.0-6.64 mg. According to Indonesian National Standard, value of the dissolved oxygen is at least 3 mg/L. Oxygen in the water will increase along with the lowering temperature. On the surface layer, oxygen level will be higher, because of diffusion between water and free air (Odum, 1971). It shows that need of fish on dissolved oxygen was met during the research.

Degree of acidity (pH) during the research was approximately between 6.4-6.59, while pH of water in the breeding tub has been suitable for catfish cultivation, with limit of quality standard at 6.5-8 according to Indonesian National Standard. Meanwhile, according to Sary (2006), when pH is larger than 9.2 and smaller than 4.8 in water, the water is considered to be polluted.

Ammonia during the research period was approximately 0 – 0,25 mg/L. Along with the research by Hermawan et al (2012) ammonia range at 0.071-0.322 mg/L is suitable and adequate for the growth of dumbo catfish. When ammonia concentration in water is high, it will lead to death in fish.

Nitrate value during the research period was between 0-25 mg/l. Low nitrate concentration with the use of biofloc technology indicated that more nitrification bacteria, nitrobacteria in this case, grow (hermawan, et al., 2014). Meanwhile, nitrite value during the research period was between 0 -1 mg/l, while proper nitrite for fish cultivation was < 1 mg/l (wedmeyer, 1977). Nitrite value in water at small quantity and unstable condition as a result of oxygen is caused by nitrite of transition from ammonia and nitrate (effendi, 2003). Nitrite concentration exceeding the limit can be fatal for fish and cause death.

4. CONCLUSION

Conclusion that can be made from this research is optimum administration of fish oil in improving EPA/DHA, ADG, and FCR is 4%, with EPA/DHA at 148.5/36 mg/100g, ADG at 0.45%, and FCR at 1.2%.

REFERENCES

1. Ardita, N., Budiharjo, A., Lusi, S., and Sari, A. 2015. Growth and Feed Conversion Ratio in Tilapia Fish (Oreochromis Niloticus) with Prebiotic Administration. *Biotechnology*, *12*(1), 16–21. https://doi.org/10.13057/biotek/c120103
2. National Standardization Agency. 2014. *Dumbo Catfish (Clarias sp.) Section 4: Feed Production*. SNI 6484.4 : 2014, 1–4.
3. Banjarnahor, M. D., Usman Syammaun., and Rusdi Leidonald. 2015. *The Effect of EM-4* (*Effective Microorganism*-4) *Prebiotic Administration to the Growth and Survival of Juvenile Sangkuriang Catfish* (*Clarias gariepinus).* Journal. University of North Sumatera.

4. Beamish, F.W.H., and Medland, T. 1986. *Protein Sparing Effects In Large Rainbow Trout Salmon Gairdneri. Aquaculture*. 55: 35-42.
5. Boyd, C. 2015. *Water Quality. Switzerland.* Springer.
6. Diana, F M. 2012. *Journal of Public Health.* Vol. 6, No.2
7. Department of Food Security and Fishery. 2018. Producing Alternative Feed for Catfish. https:dkpp.bulelengkab.go.id, accessed on March 13, 2022
8. Effendie, M.I. 2003. *Biology of Fishery.* Pustaka Nusatama Foundation. Yogyakarta.
9. Faridah, F., S. Diana., and Y. Yuniati. 2019. Catfish Cultivation with Biofloc Method in Conventional Catfish Farmers. *CARADDE: Journal of Social Service*, *1*(2), 224–227. https://doi.org/10.31960/caradde.v1i2.74
10. Hermawan, A T., Iskandar, and Subhan, U. 2012. The Effect of Stocking Density to the Survival and Growth of Dumbo Catfish (Clarias Gariepinus Burch.) In Pool of Kali Menir Indramayu. *Journal of Fishery and Marine Sciences, Unpad*, *3*(3), 85–93.
11. Hermawan, T E S A., Sudaryono A., and Prayitno S B. 2014. The Effect of Various Stocking Density to Growth and Survival of Juvenile Catfish (*Clarias gariepinus*) in Biofloc Media. *Journal of Aquaculture Management and Technology*, *2*(3), 76–85. http://ejournal-s1.undip.ac.id/index.php/jfpik
12. Iskandar, S., H. Resnawati, and T. Pasaribu, 2000. Growth and Carcass Responses of Three Lines of Local Chickens and its Crossing to Detary Lysine and Methionine. In the Proc. Of the 3rd International Seminar on Tropical Animal Production: Animal Production and Total Management of Local Resources. Faculty of Animal Science - Gadjah Mada University.
13. Istiqomah, S., Lamid, M., and Pursetyo, K. T. 2017. The Potency of Lemuru Fish Oil in Commercial Feed to the Omega-3 and Omega-6 Fatty Acids in Asian Swamp Eel (Monopterus Albus). *Scientific Journal of Fishery and Marine Sciences*, *9*(1), 37. https://doi.org/10.20473/jipk.v9i1.7631
14. Jensen, G. 1992. *Handbook for Common Calculation in Finfish Aquaculture*. LSU AgCenter Research & Extension. England.
15. Panagan, A. T., H. Yohandini., and J.U. Gultom. 2011. Qualitative and Quantitative Analysis of Omega-3 Unsaturated Fatty Acid from Catfish Oil (Pangasius pangasius) by Gas Chromatography Method. *Scientific Research Journal*, *14*(4), 38–42.
16. Pariwono. 2005. Dissolved Oxygen and Biochemical Oxygen Demand as Indicators for Determining Quality of Water. *Oseana*, *30*(3), 21–26.
17. Puteri, B J., Subandiyono, Hastuti S. 2020). The Role of Chromium (Cr+3) in Artificial Feed toward Efficiency Level in the Use of Feed and Growth. *Scientific Journal of Tropical Aquaculture*. 4(2020)2:161-170 eISSN:2621-0525
18. Pratiwy, F. M., and Pratiwi, D. Y. 2021. Virtual Counseling on Omega-3 Potency for Improving Immune System (During COVID-19 Pandemic). *Farmers: Journal of Community Services*, *2*(1), 30. https://doi.org/10.24198/fjcs.v2i1.31191
19. Madinawati., N. Serdiati &Yoel. 2011. *Different Feeding to Growth and Survival of Dumbo Catfish (Clarias Gariepinus).* Research and Development Media, Central Sulawesi IV. Volume 2.
20. Mukti, R. C., Bambang, N., Utomo, P., and Affandi, R. 2014. Fish oil supplementation in commercial diet on growth of Anguilla bicolor. *Journal of Indonesian Aquaculture*, *13*(1), 54–60.
21. Munisa, Q., Subandiyono, and Pinandoyo. 2017. Effect of Different Fat and Energy toward the Use of Feed and Growth in Catfish (Pangasius Pangasius). *Journal of Aquaculture Management and Technology*, *4*(4), 95–100.
22. Odum, E. P. 1971. *Basics of Ecology.* Third Edition, Gadjah Mada University Press. Yogyakarta.
23. Pangkey, H. 2011. The Need for Essential Fatty Acid in Saltwater Fish. *Journal of Fishery and Tropical Marine Sciences*, *7*(2), 93. https://doi.org/10.35800/jpkt.7.2.2011.185

24. Rihi, A.P. 2019. The Effect of Natural and Artificial Feeding to Growth and Survival of Juvenile Dumbo Catfish (Clarias Gariepinus Burchell.) in Breeding Centre of Sentral Noekeke, Kupang Regency. *BIOEDU*. Vol. 4, No. 2.
25. Roberts, R.J. 1989. Fish Pathology 2nd ed. Baillierre Tindall. London
26. Sanjayasari, D., and Kasprijo. 2010. The Estimate of Protein-Energy Ratio in Feed for Senggaringan Fish (Mystus Nigriceps) as Nutrient Basis for the Success of Documentation. *Journal of Fishery and Marine Sciences*. Department of Fishery and Marine Sciences, Faculty of Science and Engineering. Unsoed Purwokerto. Purwokerto. 15(2): 89-97.
27. Sary. 2006. *Course Material for Water Quality Management.* Politehnik Vedca. Cianjur.
28. Sulawesty, F., Chrismadha, T., & Mulyana, E. (2014). Growth Rate in Goldfish (Cyprinus Carpio L) with Fresh Lemna (Lemna Perpusilla Torr.) Feeding. in Pool with the Closed Flow System. *Research Centre for Limnology-LIPI*, *21*(2), 177–184.
29. Suprapto. 2013. *Cultivation of Dumbo Catfish by Applying Biofloc Technology.* Science and Technology Clinic, Mina Bisnis Pacitan. East Java.
30. Tacon, A. E. J. 1987. The Nutrition and Feeding Formed Fish and Shrimp. A Training Manual Food and Agriculture of United Nation Brazilling , Brazil. 108 pages.
31. Telaumbanua, N.H., Rusliadi., and Niken, A.P. 2018. *Growth and Survival of Dumbo Catfish (Clarias Gariepinus) with Different Stocking Density Using Booster Aquaenzyns Probiotics in Feed*. FPIK Riau.
32. Vilka, F. (2008). *Determination of Docosahexaenoate Acid (DHA) and Eicosapentaenoate Acid (EPA) in Milk Powder with Gas Chromatography.* Faculty of Mathematics and Natural Science. University of Indonesia.
33. Wedmeyer, g.a., and yasutake, w. T. 1997. *Clinical methods for the assessment of the effects of environmental stress on fish health*. Technical papers of the u.s. Fish and wildlife service. U.s. Depart. Of the interior.