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COMPILATION OF TDR LONGLINE STUDIES AND COVERAGE IN THE WCPO REGION

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Paper prepared by

David G. Itano

University of Hawaii, Pelagic Fisheries Research Program, Honolulu, Hawaii, USA

Compilation of TDR longline studies and coverage in the WCPO region

David G. Itano

Abstract

Improvements in the standardization of longline CPUE will be required if longline data is to be used for abundance indices. Standardization efforts are confounded by numerous technical, environmental, oceanographic, economic and social factors. At issue is the fact that longlines seldom fish to their predicted depth and the actual time and location of hooking by species and area are not well known. The fishing parameters of many longline fleets have also not been characterized properly. Time depth recorders (TDRs) and hook timers offer an empirical way to define these characteristics on a fleet by fleet basis. TDR and hook timer studies in the WCPO are summarized with suggestions to contact regional experts when designing TDR studies. Further use of TDRs and hook timers, especially in tropical areas less studied are encouraged.

Introduction

The accurate analysis of longline CPUE is essential for estimating indices of abundance and formulating responsive management of longline fisheries. However, longline standardization over time and fleets is complex and often data limited. Countless variables influence catch that need to be incorporated into analyses to attempt to predict changes in actual abundance or availability of target species to the fishery. Changes in gear and industry-related alterations to landings occur over time and at different rates by fleet and region. Environmental and ecological shifts are even harder to define and incorporate into stock assessment

Some variables or considerations for longline effort standardization include:

- changes in gear configurations and efficiency (mainline type, hooks per basket, branchline configurations, bait type <live bait>, number of hooks/set, use of remote sensing, etc.);

- oceanography and heterogeneity of fishing grounds (frontal zones, seasonality, biological hotspots, aggregation);

- vessel efficiency (setting/hauling/baiting gear, refrigeration type, fuel efficiency, vessel age, size);

- changes in targeting or markets (high grading/discarding, market preference);

- operational influences (extended soak time/drop off rates, bait loss,);

- environmental influences (medium or long-term shifts in productivity)

- ecological factors (niche partitioning and invasion, conspecific interaction, competition);
- economic factors (influence on overhead costs on operational range – fuel, crew, etc);
- social factors (captain and crew experience, networking, code groups), etc, etc.

Generally, analytical efforts toward longline standardization are data limited which is one reason nominal or adjusted longline CPUE from the Japanese fishery, with wide spatial and temporal coverage and consistent reporting forms the basis for longline based indices of abundance. Advancements in remote sensing and electronic tags has increased options for other standardization methods, i.e. deterministic habitat-based longline standardization. However, the current generation of archival tags provides information on habit use without important parameters such as feeding activity, spawning, predator avoidance, etc. This can and has lead to inaccurate assumptions on catchability and CPUE trends. The relationship between catch and local environmental data can also be data limited or not useful in a spatio/temporal sense.

Justification for TDR work

Efforts to improve longline standardization and current issues were recently discussed in Honolulu during the Pelagic Longline Catch Rate Standardization Meeting (February 12–16, 2007). Hoyle et al. (2007) compiled the proceedings of the meeting which should be consulted for detailed information and summaries of several useful documents. The recommendations arising from this meeting provide a useful summary of issues, problems and ways to address these problems related to longline standardization. These recommendations are included here as **Appendix I**.

Hooks per basket, or hooks between floats is used to calculate fishing depth using calculations that incorporate setting speed, line speed, etc. However, several studies have found that longlines seldom fish as deep as these calculations would suggest creating significant potential bias in catchability estimates. Also, information on vertical habitat utilization do not necessarily define the areas and depths where particular species feed or are vulnerable to baited hooks. Studies using time depth recorders (TDRs) and hook timers have attempted to address these issues. One of the recommendations from Hoyle et al. (2007) relating to observer programmes suggests the following:

Data suggestions for observer programs

- Incorporate details from table 1 in background paper 10 (Bach et al 2007).
- Validate longline gear depth with temperature depth recorders (TDR's).
- Collect gear attributes such as line types, hook types and sizes, weights, weighted swivels, bait type etc.

- Use more hook timers to validate time of capture.
- Observers to report which hook each fish was caught on, and time of day caught.
- Geographical coordinates at start and end of haul.
- Validate logbooks using observer data.

Purpose and content

Verification of the actual fishing depths of longline gear and actual hooking depths by species is clearly an important issue to address. The intent of this Information Paper is to provide a summary of published and ongoing TDR studies in the WCPO with information or contacts to TDR specialists that may be useful when planning or implementing studies.

The **PELAGIC LONGLINE CATCH RATE STANDARDIZATION MEETING** summarized TDR studies conducted in the Pacific with organization and recorded gear attributes. To take this further, researchers involved in effort standardization and TDR/Hook Timer experiments were surveyed and asked to summarize their studies within a matrix configured on their advice. This table is included as **Appendix III**.

Due to the diversity of information necessary to describe TDR studies, the information describing each study or group of studies is divided into three separate tables that reference each other: **General Information, Set Information and TDR Information**. The principal investigators or contacts for each study are given with publication references and significant findings are summarized.

Discussion

Due to the complexity of characterizing the behaviour of a longline set, the tables in **Appendix III** do not nearly address all the technical issues involved in planning and implementing a TDR/Hook timer study useful for effort standardization. It is recommended that interested parties contact the authors or field staff involved in each project when planning their own studies.

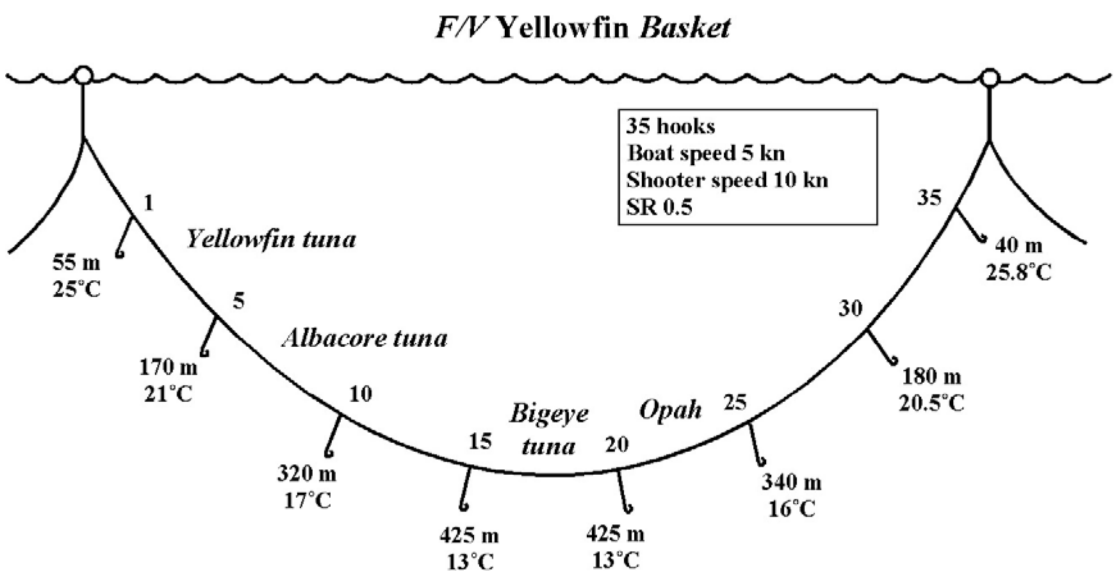
A quick look at Table 1 confirms that the majority of the larger and better documented TDR studies have been conducted at higher latitudes, often close to the more developed areas for research, i.e. Japan, Hawaii, Australia, New Caledonia or in countries connected to these areas (American Samoa). Studies are known to have taken place in New Zealand and French Polynesia as well but information was not summarized here. The American Samoa study is also well developed but information was not summarized due to time constraints.

The issue here is that important areas of the tropical and subtropical fisheries have not been well addressed with TDR or hook timer studies. It will be important to characterize the operational characteristics of lesser known fleets and species-specific hooking depths for these areas that vary widely in oceanography, productivity and vertical temperature profiles.

References

Bach, P, P. Travassos, D. Gaertner 2007.Why the number hooks per basket (HPB) is not a good proxy indicator of the maximum fishing depth in drifting longline fisheries? Background Paper 10. **PELAGIC LONGLINE CATCH RATE STANDARDIZATION MEETING** February 12−16, 2007, University of Hawaii, Honolulu, Hawaii, USA.

Hoyle, S., K. A. Bigelow, A. D. Langley, and M. N. Maunder. 2007. **PROCEEDINGS OF THE PELAGIC LONGLINE CATCH RATE STANDARDIZATION MEETING.** February 12−16, 2007, University of Hawaii, Honolulu, Hawaii, USA.



source: S. Beverly, SPC, Noumea

Appendix I. Recommendations from Hoyle et al (2007) PROCEEDINGS OF THE PELAGIC LONGLINE CATCH RATE STANDARDIZATION MEETING

Summary of recommendations

Recommendations for stock assessments – 2007

Regional weighting factors

- Consider a time period from 1975 to 1986. Re-weight using 1960-1974 and 1975-1986, and compare outcomes. Outcomes may differ between species; e.g. 1960-74 may be better for yellowfin
- Consider including interaction terms in the model, including region and hooks between floats (HBF)

Data resolution, and analyses using other datasets

- Set by set analyses for target species are recommended, both to compare indices with those from aggregated data and to investigate factors that might affect catch rates. Suitable data sources include:
  - Hawaii-based longline data: e.g. moon phase, time of day of set, bait type, vessel id, vessel length. Compare with coarser 1º and 5º monthly data..
  - Within-EEZ logsheet data for all longline fleets, particularly regarding gear configuration
- Spatial and effort contraction of the Japanese longline fishery over the past decade makes it important to include other datasets in order to develop CPUE indices relevant for the entire WCPO.
- Compare nominal indices of the Japanese fleet and other fleets at appropriate spatial and temporal scales.
- Explore standardization for Korea and Taiwan CPUE for a global CPUE index
- Where possible, indices for all countries to be made available.

Examine sensitivities of the stock assessment models to assumptions in the GLM.

- Examine sensitivity to the assumption that HBF=5 before 1975.
- Examine sensitivity to the assumption that HBF effects are equivalent throughout the time period, given that longline material specific gravity may have changed for many vessels during and after 1993.
-

Examine sensitivity to plausible increases in fishing power. Define 'plausible', perhaps via a paper from Peter Ward. See also paper by Miki Ogura on pole and line fishery, presented to SCTB several years ago.

-
Attempt to standardise using data only from main gear configurations – this implies subdividing the CPUE index. Is data for specific gear configurations available? Yokawa-san will ask Okamoto-san, and provide if it is reliable.

Reporting at the WCPFC Scientific Committee

-
Report against biological hypotheses – compare model parameterization to biologically-based expectations, such as HBF.

-
Explain implications of statistical assumptions in terms of biology, fleet dynamics, and population dynamics.

Compare depth distribution from archival tags with depth/habitat at capture on longlines for all species.

Recommendations for stock assessments – Longer term

Spatial effects

-
Develop standardization using spatial backfilling – investigate effects of alternative approaches, (e.g. Campbell *et al*, Ahrens PhD research, and Maunder - combining pop dynamics and GLM).

-
Develop methods to include uncertainty in spatial back-filling approaches.

-
Model population dynamics of region 3 at a smaller spatial resolution, to examine potential effects of spatial heterogeneity in fishing effort and population structure.

-
Compare results of a simple GLM, an area-weighted model, and an abundance-weighted model.

-
Given the geographical diversity of region 3, and the limited information regarding the western part of region 3, carry out a sensitivity analysis to removing the western part from the CPUE analysis.

Modelling approaches

-
Determine which of the currently available methods for standardizing CPUE are generally applicable and the conditions under which they will perform better than other methods.

-

When using simulation analysis, start with simple models to test the utility of existing methods and test where the methods break down. Build in increasing complexity to determine their performance in realistic applications.

- Review literature on CPUE standardization, and note covariates and factors for which standardization substantially changes the year effect from nominal CPUE.

- Combine GLM with pop dynamics model – examine outcomes via simulation

Missing covariates,

- Take a statistical approach to estimating missing observations, using the EM algorithm for example.

Time horizon

- Given the uncertainty about the factors affecting pre-1975 CPUE, consider starting assessments in 1975 instead of 1952, or at least using only the post-1975 period to infer long-term average recruitment. Consider the implications for the assessment model and for management.

Targeting

- Cluster analysis for Japanese data to compare the observed clustering with HBF and area targeting information, in order to see how well the clustering approach works. This can be used to validate the approach for other fleets.

- Market demand (by species, fish condition, fat content (also affected by area & time of year)) can affect targeting. Consider how market demand can be integrated into the determination of targeting

- Consider how oceanography can be integrated into the determination of targeting.

- Review approaches for including data from other species in GLMs.

- Investigate simultaneous standardization across species to resolve changes in targeting behaviour.

- Investigate analyses of targeting that include data from multiple fleets.

Data resolution, and analyses using other datasets

- Develop CPUE indices for all countries/fleets where longline data exist.

Data requirements

- Determine the status of current data holdings, including identifying the nature and magnitude of deficiencies, and determine the priority for data collection for current model applications.
- Identify what data should be collected in the logbooks for all fleets to improve our ability to capture changes in the relationship between catch and effort, and to ensure the ability to maintain the information context and usefulness of long-term data series.

Quantify changes in gear configuration, and time series changes in catchability

- Further development to include additional species and to estimate actual gear depth using multi-species statHBS approach.
- Develop alternative likelihoods for multi-species approach.
- Investigate possibility that major discontinuities (10−25%) in CPUE indices are related to introduction of new technologies.
- Examine CPUE indices to investigate the possibility of simultaneous changes in catch rates across multiple oceans / species.
- Investigate the effectiveness of a variety of equipment, such as acoustic Doppler current profiler (ADCP).
- Review Japanese research reports for information on gear configuration changes in 1975, 1993, and at other times.
- Investigate possible changes in gear selectivity at 5 HBF pre- and post-1975 for Japanese longline vessels in the Pacific (as noted for similar vessels in the Indian and Atlantic Oceans).

Sensitivity analyses to known or potential changes in gear configuration

- Mainline composition changed with the introduction of monofilament in 1990s. HBF changed, but depth may not have. This change was associated with diversification of gear configurations. Examine potential sensitivity of year effect to this change.
- Estimate separate catchabilities before and after 1975 in the assessment model, sharing selectivity.

Recommendations relating to PFRP project

Data suggestions for observer programs

- Incorporate details from table 1 in background paper 10.
- Validate longline gear depth with temperature depth recorders (TDR's).
- Collect gear attributes such as line types, hook types and sizes, weights, weighted swivels, bait type etc.
- Use more hook timers to validate time of capture.
- Observers to report which hook each fish was caught on, and time of day caught.
- Geographical coordinates at start and end of haul.
- Validate logbooks using observer data.

Other data collection recommendations

- National scientists to describe fishery gear configurations, particularly upon introduction of new gear technologies.
- Possible provision of Japanese longline data stratified by material type.

Oceanographic effects

- GLM with CPUE as a function of oceanography alone, without temporal and spatial effects, to explore how oceanography (which is confounded with space and time) may affect catch or CPUE.
- Review availability of fine-scale spatial and temporal oceanographic data, especially remotely sensed rather than model-derived data. Compare coherence of both data types, and investigate biases.
- Use existing and develop new algorithms, at appropriate spatio-temporal resolution, to describe the evolution, decay, and persistence of features such as eddies and frontal structures, for both fish accumulation and fishery targeting.

Model selection

- Investigate alternative hypotheses, and use model averaging to integrate over model selection uncertainty where it occurs.
-

Develop tests appropriate for determining which standardization methods provide the best index of relative abundance from a set of candidate methods.

-

Evaluate the performance of candidate tests using simulation analysis.

Gear dynamics

-

Further experiments to quantify longline shoaling due to horizontal current shear and changes in sag ratio.

-

Characterize intra-set variability in gear depth, and statistically determine optimum number of TDR's given variability.

-

Investigate functional relationship relating depth fished with HBF/longline material.

Appendix II. Summary of gear configuration from observer programs and research cruises from Hoyle et al. 2007.

	Period	Owner
Central Pacific experimental longline research	1989−1997	PIFSC, NOAA Fisheries
Gear configuration attributes: • Longline dimensions, setting and hauling details • Each catch identified by hook number and time, body size (length) • TDRs and hook-timers deployed • 118 tuna sets (56,000 hooks) and 122 swordfish sets (41,000 hooks) observed		
Australian domestic observer program	Period	Owner
	2001−Present	AFMA
Gear configuration attributes: • Longline dimensions, setting and hauling details • Each catch identified by hook number and time, body size (length)		
Australian observers on licensed Japanese longliners	Period	Owner
	1980−1996	AFMA
Gear configuration attributes: • Longline dimensions, setting and hauling details • Time of each catch recorded, body size (length)		
CSIRO Coral Sea Survey of commercial Australian longliners	Period	Owner
	1995−1996	CSIRO
Gear configuration attributes: • All catch species identified by hook and time • TDRs (archival tags) and hook-timers deployed • 109 sets observed and 234 TDR observations collected		
CSIRO project − Determination of effective effort in the Eastern Tuna and Billfish Fishery (ETBF)	Period	Owner

	August 2004−Present	AFMA
Gear configuration attributes: • Two sets of TDRs (~10 per set) and hook-timers (~80 per set) deployed by AFMA observers on commercial Australian longliners operating in the ETBF. All trips departing from port of Mooloolaba • Full observer logsheets recorded • 290 sets observed and ~1,680 TDR observations collected as of December 2006		
French Polynesia EEZ	Period	Owner
	1993−1997	IRD & French Polynesian Fishing Services
Gear configuration attributes: • Longline dimensions, setting and hauling details • Each catch (2,230 fish) identified by hook number and time, body size (length) • Tuna capture − 354 bigeye, 258 yellowfin and 638 albacore • TDRs and hook-timers deployed • 160 sets observed and ~1,400 TDR observations		

Appendix III. Compilation of information on TDR studies in the WCPO region

Table 1. General information on TDR studies

Ref No.	Geographic location	Time span	Target species	Type of set	Publications or PIs or study name	Significant findings or current status
1	central North Pacific, Hawaii based	Feb 1996 - April 1999	sword	shallow night	Bigelow, K., Musyl, M.K., Poisson, F., and P. Kleiber. 2006. Pelagic longline gear depth and shoaling. Fisheries Research 77 (2006) 173-183.	Shallow sets only reached 50% of predicted catenary depth. Deep tuna sets reached approximately 70% of predicted catenary depth. GLMs and GAMs were developed incorporating predicted catenary depth, wind stress, surface current velocity and current shear that explained a high percentage of discrepancy between unadjusted predicted depth and TDR data.
2	central North Pacific, Hawaii based	Feb 1996 - April 1999	bigeye	deep day	Bigelow, K., Musyl, M.K., Poisson, F., and P. Kleiber. 2006. Pelagic longline gear depth and shoaling. Fisheries Research 77 (2006) 173-183.	
3	central North Pacific, Hawaii based	2007 - ongoing	bigeye	deep day	Seki, M., Hawn, D., Polovina, J. The Use of Temperature-Depth-Recorders in the Hawaii-based Longline Fishery to Characterize Bigeye Tuna (Thunnus obesus) Fishing Grounds	ongoing
4	Shoyo-maru North Pacific	2004	striepd marlin & sailfish	deep & shallow day	in analysis ISC/05/MAR&SWO-WGs/ 14. Vertical distribution pattern of CPUE for striped marlin in the North Pacific estimated by the with data of the time, depth and temperature recorders collected through a longline research cruise of Shoyo-maru in 2004 in the north east Pacific, preliminary results. Kotaro Yokawa, Minoru Kanaiwa, Yukio Takeuchi, and Hirokasu Saito	in analysis Estimation of vertical CPUE pattern of striped marlin caught by longline gear
5	Shoyo-maru	2006	bigeye	deep day	in analysis	in analysis

6	Shoyo-maru	1995	bigeye	deep day	Mizuno et. al., (1996) A micro Bathyermograph system for tuna longline boats in view of large scale ocean observing system. Bull. Nat. Res. Inst. Far Seas Fish., No. 33, 1-15.	Developpment of the micro baththermograph.
7	Shoyo-maru	1997	bigeye	deep day	Mizuno et. al., (1997) Estimation of Underwater shape of tuna longline by using micro-BTs. Bull. Nat. Res. Inst. Far Seas Fish., No. 34, 1-24. Okazaki et. al., (1997) Improved model of micro bathythermograph system for tuna longline boats and its application to fisheries oceanography. Bull. Nat. Res. Inst. Far Seas Fish., No. 34, 25-41. Mizuno et. al., (1998) Fluctuation of longline shotening rate and its effect on underwater longline shape. Bull. Nat. Res. Inst. Far Seas Fish., No. 35, 155-164. Okamura et. al., (1998) Estimation of the distance between the floats of longline on the sea using the GPS. Bull. Nat. Res. Inst. Far Seas Fish., No. 35, 165-175.	Adress the basic theory for the estimation of the underwater shape of longline gear.
8	South West Pacific - New Caledonia EEZ	2003-2004	tuna	Deep & shallow day	Chavance P.N. Campagnes de pêche à la palangre dérivante instrumentée dans la ZEE de Nouvelle Calédonie - Rapport Final ZoNéCo - Mars 2005 // CHAVANCE P.N., 2005. Depth, temperature and capture time of longline targeted fish in New Calédonia : resultas of a one year study. WCPFC-SC1-FTSWG IP3	Shallow set targeting max. depth between 250-300m --> max depth reached : 200-320 m (for 80% of baskets) Deep set targeting depth between 400-500 m --> max depth reached : 300-510 m (80%) /// Maximum yield for all commercial species combined occur in the upper 100m / Down to 200m, sharks catches are considerable // complete disappearence of non-marketable species at depth greater than 300 m

9	central North Pacific, Hawaii based	2006	bigeye	deep day	Beverly, S., and D. Curran Gear trials of deep set longline technique vs. standard tuna longline techniques	Deep set technique ensured that all hooks fished below 100 meters depth, vs. standard technique where 6 hooks per basket fished shallower than 100 meters depth.
10	New Caledonia	May-05	tuna	deep day	Publications: Beverly, S. 2005. Notes on a longline trip in the New Caledonia EEZ using TDRs in combination with remote sensing data (SSH and SST). http://www.wcpfc.int/sc1/pdf/SC1_FT_IP_4.pdf	Effective setting parameters for bigeye and albacore however, vessel owner chose to target albacore due to market. Bigeye caught 320-423m, albacore caught 170-320 m. Basket profile determined using multiple TDRs on same basket. # of hooks decreased based on study and succeeded in targeting albacore
11	American Samoa	2007 - ongoing	tuna	deep day	Bigelow, K. American Samoa Albacore Tuna Habitat and Oceanographic Characterization of the American Samoa Fishing Grounds	
12	Indonesia Benoa, Bali	Jun-07	tuna	deep day	Proctor, C. (CSIRO Hobart)	Have trained six observers in use of TDRs and hook timers. Initially, have 6 TDRs and 200 hook timers. Hope to expand gear inventory.
13	South Pacific	2007 - ongoing	tuna	deep day	Sharples, P., Hampton, J. (SPC Noumea)	10 hook timers funded by WCPFC on recommendation from SC2. Plan to increase inventory and coverage with time. Large inventory of TDRs budgeted for EU funding
14	Eastern Australia	ongoing	tuna sword	deep day & shallow night	Campbell, R. Use of TDRs and hook-timers to ascertain fishing depths and times of capture in the Australian Eastern Tuna and Billfish Fishery. CSIRO, Hobart, Australia.	To be reported in SC3 FT SWG as FT WP-1 related studies reported to SC2, FT WP-2

Table 2. Set details for TDR studies

Ref No.	Number of sets	Number of trips	Hooks/basket	Mainline diameter (mm)	Setting speed (SOG Kts)	Line shooter speed	Hook Interval (time or speed)	Line weights (g)	Floatline length (m)	Branchline length (m)
1	333	59 (Study 1+2)	mean: 4.3 range: 2-6	3.8 + - 0.4	7.67 + - 0.85	NA	NA	64.7 + - 12.2	10.3+ - 7.0	16.4+ - 5.4
2	266	59 (Study 1+2)	mean: 26.8 range: 20-32	3.5+ - 0.3	6.70 + - 0.71	9.06 + - 2.15	NA	51.8 + - 13.1	20.9+ - 6.1	13.4+ - 4.6
3	ongoing									
4	30	3	approx 190	4.2mm	varies by set	varies by set	NA	NA	varies by set	varies by set
5	36	2	approx 200	4.2mm	varies by set	varies by set	NA	NA	varies by set	varies by set
6	22	2	50	4.2mm	varies by set	varies by set	NA	NA	varies by set	varies by set
7	11	2	60	4.2mm	varies by set	varies by set	NA	NA	25m	32m
8	43 (8100 hooks)	12 (1/month)	25	3.5	shallow : 3,5-4,5 kts // deep : 2,5-3,5 kts	shallow : 0 (taut) // deep : 6-8 kts	shallow : 18s // deep : 16 s	60g swivels	20 m	10-12 m
9	90	7	27 (control) 30 (deep set)	3.6	7	12 kts	5 seconds	45	25	15
10	5	1	35	3.5	5 kts	10 kts	7 seconds	45 gr	10 m	10 m
11	ongoing									
12	ongoing									
13	ongoing									
14	To be reported in SC3 FT SWG as FT WP-1. Related studies reported to SC2, FT WP-2									

Table 3. TDR information from studies

Ref No.	Target species	Type of set	TDR mfg	TDR model	# TDRs per set	Sampling rate	TDR depth (mean, SD)	TDR depth range (m)	Minimum TDR Temp °C (mean, SD) <median>	Depths predicted in study (Y/N)	Hook Timers used (Y/N)
1	swordfish	shallow night	Wildlife Computers	MK2 MK3e	1	every 5 min	63.9+ - 28.9	15 - 178	18.1+ - 4.2 <17.7>	Y	N
2	bigeye tuna	deep day	Wildlife Computers	MK2 MK3e	1	every 5 min	243.6+ - 83.2	60 - 504	12.6+ - 3.8 <11.6>	Y	N
3	bigeye	deep day									
4	striepd marlin & sailfish	deep & shallow day	Murayama Electric Co.	SBT 500	approx 190	10 seconds	in analysis	in analysis	in analysis	Y	N
5	bigeye	deep day	Murayama Electric Co.	SBT 500	approx 200	10 seconds	in analysis	in analysis	in analysis	Y	Y
6	bigeye	deep day	Kankyo-keisoku System Co.	DTM	50	10 seconds	NA	NA	NA	Y	N
7	bigeye	deep day	Murayama Electric Co.	SBT 500	60	10 seconds	NA	NA	NA	Y	N
8	tuna	deep & shallow day	MICREL S.A.	P2T 600	8 1/basket	2 mn	Shallow : 256 " 45 // Deep : 430 " 109	Shallow : 166-359 /// Deep : 235 - 754		Y	Y

9	bigeye	deep day	Star Oddi	XYZ-2 (?)	4 to 8	1min	shallowest hook: control (44+ - 7.7), deep set (103+ - 8.0) Deepest hook: control (211 ± 28.7), deep set (248+ - 27.8)	shallowest hook: control (25-57), deep set (83-127) Deepest hook: control (140-260), deep set (200-320)	Shallowest hook: control (23.8+ - 2.6)<24.2>, Deep set (15.3 ± 2.3)<14.5> Deepest hook: control (20.7 ± 2.7)<22.0>, deep set (13.9 ± 1.7)<13.8>	Y	N
10	tuna	deep day	Star-Oddi	DST-Centri	8	10 min	mean 393 m	350-425 m	mean 14.0 C	Y	N
11	tuna	deep day									
12	tuna		nke-microtel SP2T 1200								Y 200 units
13	tuna	deep day									
14	tuna sword	deep day & shallow night	To be reported in SC3 FT SWG as FT WP-1. Related studies reported to SC2, FT WP-2								